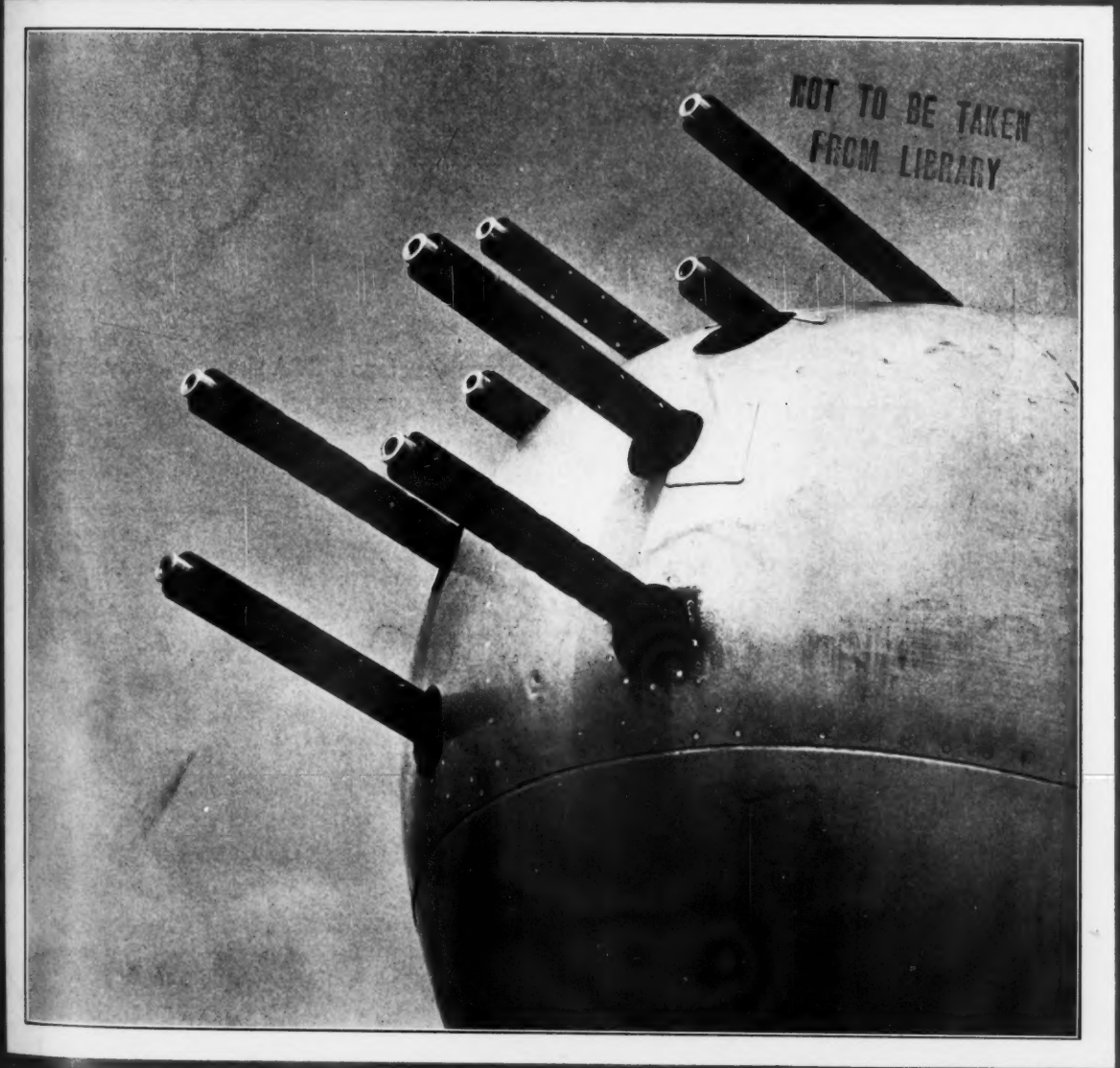
AERONAUTICAL ENGINEERING REVIEW

INSTITUTE OF THE AERONAUTICAL SCIENCES

OCTOBER 1944



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Engineering Responsibility

(A Guest Editorial)

GLENN L. MARTIN*

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AS IT BECOMES more and more apparent that Allied arms ultimately will triumph in this most frightful of all wars, the aeronautical engineer faces a new responsibility of turning the most devastating weapon of war into the most potent instrument of peace.

This accountability goes much farther than simply designing and producing new aircraft; it involves as clear a concept of the airplane's needs and uses and effects in a complicated peacetime economy as of its tactical and strategic place in the vast conflicts of armies and navies. Which means that the engineer must broaden the scope of his vision to embrace the influences that will dictate the directions of his efforts.

This, in turn, means that much responsibility will fall upon the engineering societies. They must enhance and reflect the technical progress of the profession, as they always have done, but they also might profitably encompass the social, economic, political, and educational influences that bear upon the aeronautical engineer and his products.

It is hardly necessary to repeat that aviation's engineers have been one of the most powerful influences in this war. The *blitzkrieg* of the air, based far more on quantity than on quality of aircraft, was to have been the victory wing of the aggressor nations. Quality stopped quantity, and quantity of quality carried the weight of the first conspicuous Allied successes. And with air superiority established, the Allies have continued their inexorable march toward victory.

Quality, then, was the turning point. Allied ingenuity has consistently outinvented the Axis. Indeed, some of Germany's latest weapons were actually invented by

American and British engineers long ago and discarded. The flying bomb is an example.

But the point is that the aeronautical engineer acquainted himself with the arts of war, designed and built and refined his airplanes to fit into the broad pattern. He understood the need for rapid change and development and, understanding, he changed and refined with intelligence and real purpose.

Such an awareness has been much of the key to the Allied successes. But it might be added that military and naval strategists and tacticians have been unstinting in their efforts to keep the engineering profession informed.

To turn these swords into plowshares, to return the airplane to its original purpose as a peaceful vehicle, is a much more complex task. Just as it was necessary for the engineer to understand the strategy and tactics of war, so will it be necessary for him to understand the influences upon peaceful commerce. The difference is that he will be dealing with widely dispersed factors, instead of closely integrated planning such as he has become accustomed to in the arts of war.

The kaleidoscope of commercial competition, the modes and foibles of humanity, the whims of politics, the steadier and more basic (though ever changing) factors of demand and supply—all of these have a direct and powerful bearing on the work and achievements of the engineers of aviation in all their broad range.

It is not enough that we leave such tiresome things to "front office" and "sales." Only by a thorough understanding of our markets and the pressures that direct them can we approach comprehendingly the creative tasks that face us.

Aviation is on the threshold of its greatest opportunity—an opportunity it has long sought. For the first time in history the world is prepared to trust the airplane. In it people see an appealing personal vehicle, an ideal public carrier, a magic carpet to transport them lands away. Perhaps they see more than is there. With colder eye, business and industry look upon the airplane with hope and interest. Attracted by speed, they yet look sharply for economy of operation—the factor that kept the brakes on commercial aviation in the prewar period. More than this, they look for vehicles each suited to specific purposes of commercial fields.

The individual engineer and the engineering society have rare opportunities—the former to take a realistic view of the job ahead of him and to make proper and embracive plans for it; the latter to provide the platform of interchange and education, not alone in technical and scientific fields, but along the whole front of aviation's expected progress.

In such fashion can the aeronautical sciences contribute most to the health of the aviation industries and the welfare of humanity.

* President.

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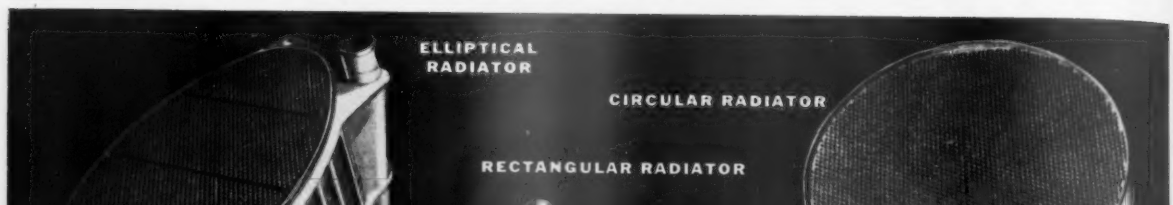

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Aircraft Power-Plant Fire Protection

HARVEY L. HANSBERRY*
Civil Aeronautics Administration

ABSTRACT

To minimize the fire hazards inherent in aircraft-engine installations, fire tests of operating, full-scale installations under simulated flight conditions have been conducted by the Technical Development Division of the Civil Aeronautics Administration for the past 4 years. The objectives of the tests have been to determine criteria for the design of fire-resistant engine installations in future aircraft, and to develop fire-extinguishing systems for use in engine installations of aircraft already in service. In the tests, four basic investigations were made concerning fire resistance of materials, fire sources, fire detection, and fire extinguishment.

The material tests have proved the superiority of steel over aluminum alloy in and around the engine installation. In addition, these tests have shown the vulnerability of monocoque structures to fire and the relative strength of welded steel tube structures when exposed to fire. The ignition tests have proved that installation components, such as engine exhaust stacks and carburetor air-heating systems, should be located at the top of engine installations. The detector tests have indicated the best detector types for use in engine installations and the proper detector locations. The extinguishing tests have led to the development of systems and determinations of agent application requirements for extinguishing engine fires.

It is not within the scope of this paper to present in detail the results of all the tests conducted. However, its purpose is to point out the relatively minor changes necessary to make the usual engine installation fire-resistant and the advantages of good original design over faulty design with an elaborate extinguishing system.

INTRODUCTION

THE PROBLEM of providing adequate fire protection for aircraft-engine installations in flight has existed since the first flight of power-driven aircraft. However, only with the advent of the modern commercial air carrier did the fire problem become critical. Foolproof and practical devices for safely removing crew and passengers from a commercial plane in flight have never been developed. As a result of this, personnel must remain in a commercial airplane regardless of any emergency that might arise. In order to insure some degree of safety to aircraft personnel in the event of fire in flight it became necessary to develop means for combating the fire, thereby permitting the plane to return to the ground under proper control. In addition, it became necessary to eliminate all probable ignition sources and to develop fire-resistant construction if the fire hazard were to be minimized.

During the latter part of the nineteen thirties a number of engine failures occurred in commercial air carrier flights. Several of these engine failures resulted in power-plant fires. Available literature on aircraft fire protection revealed that some full-scale testing had been done by the military services and private industry.[1–10] In many of the tests only components of engine installations had been tested. Even in the full-scale tests of complete installations actual flight conditions were only partially simulated and the test equipment consisted mainly of obsolete in-line engines. Obviously, results of such tests were inapplicable to modern, high-powered, tightly cowled, air-cooled radial engine installations. Accordingly, the Technical Development Division of the Civil Aeronautics Administration began a series of investigations with the following purposes: (1) to develop practical fire detectors; (2) to develop adequate fire-extinguishing systems; (3) to determine design criteria for building heat-resistant engine installations; and (4) to determine ignition sources and means for eliminating or minimizing the hazards resulting from those ignition sources.

DESCRIPTION OF THE TESTS

In order to simulate the conditions prevalent during an engine fire in flight, tests are conducted as described. Each test unit, comprising a full-scale operating power-plant installation, nacelle or fuselage, and wing stubs, is constructed of fire-resistant materials because of the need for conducting hundreds of tests in order to obtain reliable results. This unit is placed at the outlet of an open-type wind tunnel. The engine-propeller controls, fire-extinguishing controls and containers, and supply tanks of fuel and oil to operate the engine and to furnish fuel for the fires are remotely located. The engine-propeller controls, fire-extinguishing system feed lines, and engine fuel line are led into the installation through the wing stubs. Fuel for the fires is led into the installation through a flexible hose with an appropriate nozzle. The nozzle includes a standard high-tension ignition plug located near the outlet which provides spark ignition for the test fires.

During fire tests the test unit is subjected to the air blast of the wind tunnel, and the engine-propeller combination is operated at cruising power in all tests. The flexibly connected fire nozzle may be located at any point in the installation as a source of gasoline or oil fire to simulate fires that might result from failure of the engine or the fuel or oil systems. As no appreciable quantities of gasoline can be released in the power section of radial-engine installations, test fires at that location burn oil only. In the accessory sections of such installations both oil and gasoline fires are tested. The rates at which gasoline and oil are fed to the test fires are those that could result from failures in an actual installation. Test fires burning gasoline are easily ignited by the spark provided, but oil fires are generally ignited by means of a small spark-ignited gasoline fire. Oil burned in the tests is preheated to 300°F. to simulate an overheated engine condition.

Extinguishing tests are conducted by allowing fires to burn for 30 sec. and then applying an extinguishing agent. It is assumed that an airplane crew, warned of fire by a quick-acting fire detector, can perform the necessary duties and apply the extinguishing agent well within this 30-sec. period. In successive tests, the agent distribution systems are revised, the quantities and rates of application of the agents are varied, different extinguishing agents are used, and the location and direction of the fire itself are changed. This procedure is continued until the developed distribution systems, used in conjunction with extinguishing agents applied at the proper rate and for the shortest time, will extinguish all fires regardless of the fire location, direction, or size. Hundreds of tests are necessary to determine these optimum distribution systems, minimum agent application rates, and

Presented at the Power Plants and Propellers Session, Twelfth Annual Meeting, I.A.S., New York, January 25–29, 1944.

* Aeronautical Engineer, Aircraft Development Section.

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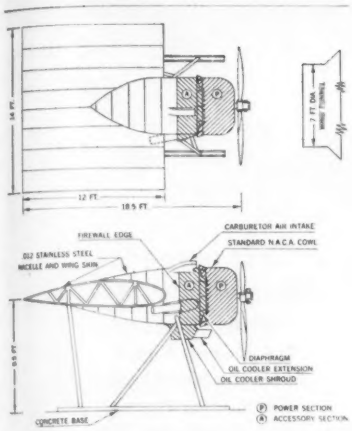

FIG. 1. Test unit of DC-3 airplane.

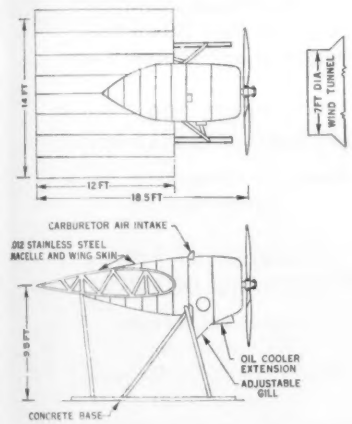

FIG. 2. Test unit of CW-20 airplane.

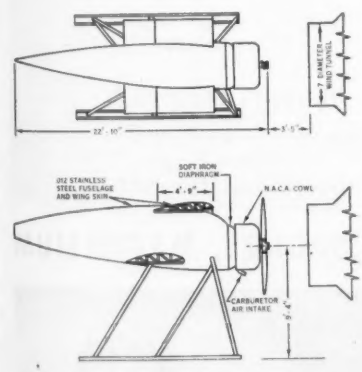

FIG. 3. Test unit of Waco airplane.

minimum agent quantities. During these tests ample opportunity is given for comparing the various extinguishing agents and for substantiating such comparisons.

Fire-detector tests in the power section are preceded by the determination of an arbitrary test-fire size. This is a small fire which would not be immediately damaging to the primary structure of the aircraft but which should be detected within 3 sec. of its ignition. Detectors are widely spaced around the power-section air-outlet area and are moved closer and closer together in successive detector fires until the connected warning signals operate within 3 sec. of the fire start or until the detectors are enveloped in flame. Thus the spacing for particular detector types can be determined. In the accessory section, because of the air stratification that is prevalent, test-fire sizes and locations must be varied until the detector spacing that will provide detection of any fire within 3 sec. is determined. Additional tests are conducted in the laboratory in which detectors, subjected to a gasoline blowtorch flame of 2,000° to 2,200°F., can be properly compared for speed of operation.

Materials tests are conducted in conjunction with the extinguishing and detector tests by carefully observing the effects of fires on the various component parts of the installation. Particular tests are conducted on metallic and on nonmetallic substitute fire-wall materials by replacing panels of the installation with panels of the test materials. In many of these tests 25 chromel-alumel thermocouples are located throughout the test unit. These thermocouples are connected to a bank of pyrometers which is photographed every 3 sec. during fire tests, giving continuous temperature recordings.

Ignition tests are conducted at the most opportune times during other test programs. During extinguishing, detector, and materials fire tests, the entire test unit deteriorates because of the temperature conditions and the corrosive effects of the extinguishing agents. This results in cracks and holes in the exhaust system, separation of cylinder exhaust stacks from the cylinder, failure of engine oil lines and fuel lines, damage to oil coolers, the deterioration of carburetor air intake systems, and holes and cracks in the fire-resistant bulkheads. Thus many ignition sources are encountered which might otherwise be neglected. When such a source does occur, the investigation being conducted is delayed until the ignition source is determined, studied, and eliminated or minimized during a series of ignition tests.

As in all test programs of this nature, adherence to previously determined schedules is impossible. The problems must be met and eliminated as they occur, and only by repeated testing can correct conclusions be substantiated.

Specific Objectives and Limitations of the Tests

The specific objectives of the tests have been, first, to develop adequate fire protection for the engine installations of aircraft already built and in service, and, second, to provide design criteria that will lead to the incorporation of fire-resistant engine installations in future aircraft.

Up to the present time, the test units have included only radial air-cooled engine installations that have been used primarily in air carrier work. The first unit tested was the DC-3 engine installation with an air-cooled, twin-row, radial engine (see Fig. 1). This unit was chosen first because of the wide use of the DC-3 as a commercial carrier. The second unit tested was the CW-20, which was considered as one probable successor to the DC-3 (see Fig. 2). The CW-20 test unit included the same power plant as the DC-3 test unit. The major difference between the two types was that the DC-3 incorporated a fireproof bulkhead between the power and accessory sections in addition to the usual fire wall, whereas in the CW-20 the power and accessory sections were not separated but were combined into one large zone separated from the nacelle by the usual fire wall. The third engine installation tested was that of the Waco YKS-37 airplane (see Fig. 3). This was tested because it was a typical medium-powered, private-owner type airplane and because it was similar to the DC-3, except that it was lower powered, smaller, and less complex, incorporating a single-row radial engine.

In-line and liquid-cooled engines were not included in the earlier tests because these engines were not widely used in commercial work. Although Diesel fuel

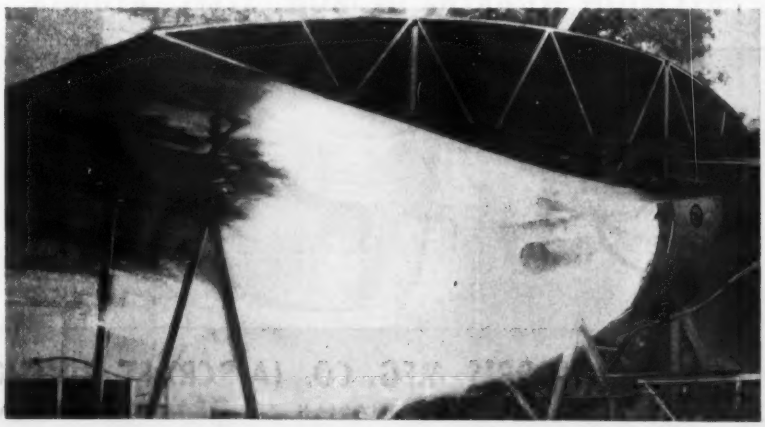

FIG. 4. Typical DC-3 power-plant fire.

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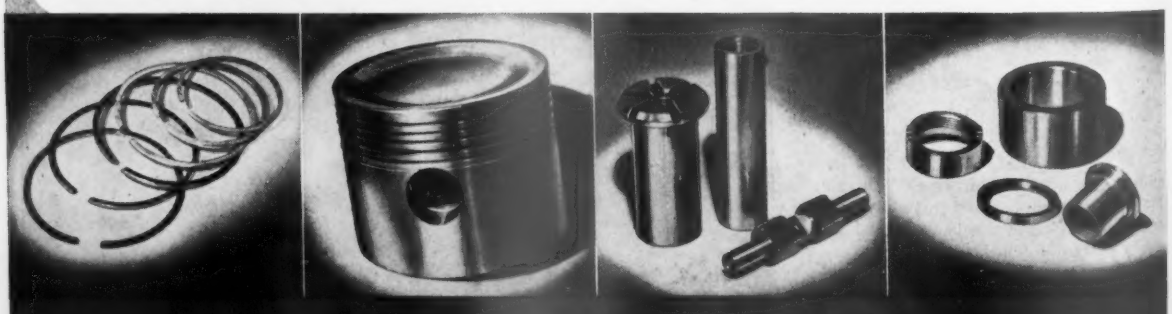

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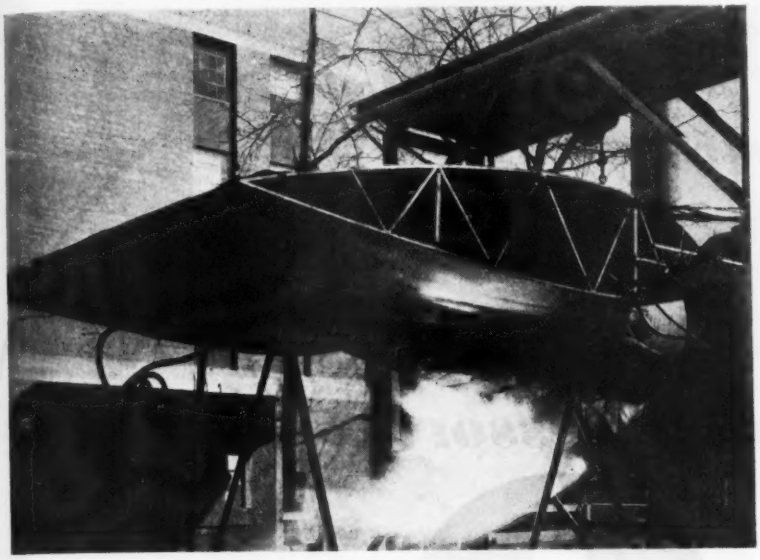

FIG. 5. Typical CW-20 power-plant fire.

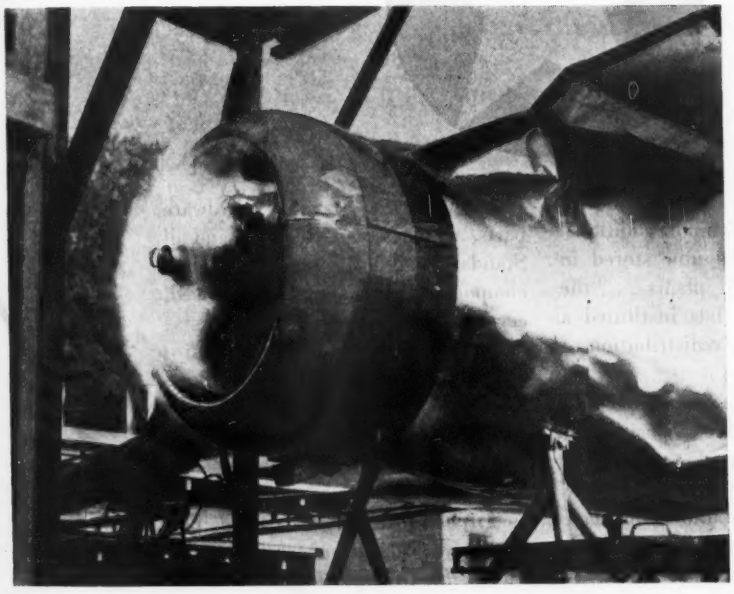

FIG. 6. Typical Waco power-plant fire.

was burned in some of the Waco test fires, much work remains to be done on the fire protection of Diesel aircraft engines if these engines become popular.

To emphasize the need for conducting great numbers of tests in programs of this nature, Table 1 gives data on the tests conducted. Figs. 4, 5, and 6 are photographs of typical fires in the three installations tested.

TABLE 1
Fire-Test Statistics

Test Unit	Fire Tests	Laboratory Tests	Total Tests
DC-3	1,422	457	1,879
CW-20	799	255	1,054
Waco YKS-37	812	450	1,262
	3,033	1,162	4,195

Engine Fire Protection for Future Aircraft

Modern fireproof buildings are *not* inflammable affairs with elaborate fire-extinguishing systems. They are structures that are built to resist fire and maintain their integrity whether or not fire-extinguishing systems are provided. This should also be true of aircraft-engine installations. Fire protection of these installations, like other desirable features of an airplane, must be considered in the original design. Fire resistance of engine installations should not be added after all other requirements are satisfied. In attempting to add fire protection to aircraft already in operation, the result is at best a second choice involving additional weight and complexity in engine installations that are already complex. It is highly probable that fire-resistant engine installations can be built which will be little heavier than the usual design. A fire-resistant installation should definitely be lighter than the usual design with the added weight of an elaborate extinguishing system.

If an engine installation could be proved completely fire-resistant, the fire-extinguishment system might be entirely eliminated. It is believed that the total amount of extinguishing agent required may be reduced as the fire resistance of an installation is increased. This results from the fact that, in the event of fire in a properly designed installation, flows of inflammable fluids can be stopped as soon as the fire is detected. This will cause considerable decrease in fire intensity and severity in a matter of 10 to 30 sec., depending on the characteristics of the fluid feeding the fire. During this time the installation will be capable of withstanding and preventing the spread of the fire. With the fire reduced to small proportions, the release of a lesser quantity of extinguishing agent should be sufficient to wipe out the last vestiges of flame. It should be remembered that the primary purpose of fire-resistant engine installation construction is not to prevent damage to the engine but to prevent destruction of the airplane. Obviously, minimization of damage to the power plant is highly desirable, but it is not the ultimate objective.

The changes required to make the usual engine installation fire-resistant are obvious in most instances but until the present have lacked sufficient substantiation. These changes involve change of materials in some cases and change of structure or other designs in other cases. Among the simpler necessary revisions are the relocations of several of the components of the usual installation. The required modifications are not difficult to make and they do not result in an installation that is unreasonably heavy. In fact, several of the newer aircraft have incorporated both fire-resistant construction and complete extinguishing systems in the engine installations.

MATERIALS

The most important change required is from monocoque structures employing aluminum-alloy skin to welded steel tube structures. Stressed aluminum-alloy skin is particularly vulnerable to power-plant fires, disintegrating after being exposed to such fires for periods of 10 to 30 sec. This results in loss of the engine and/or damage to the primary structure of the aircraft. Fig. 7 shows

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an aluminum-alloy cowl piece damaged by fire. In monocoque nacelle designs, the superiority of stainless steel sheet over aluminum-alloy sheet is not great enough to provide sufficient strength to maintain the integrity of the structure when subjected to flames of 2,000° to 2,200°F. In this temperature range even stainless-steel sheet buckles and loses considerable strength and cannot be expected to support the normal loads imposed by the engine. Therefore, the welded steel tube structure is recommended.

During the fire tests, engine mounts fabricated of welded SAE 4130 steel tubing withstood hundreds of test fires of 2,000°F. for periods of 30 sec. or more without failure.

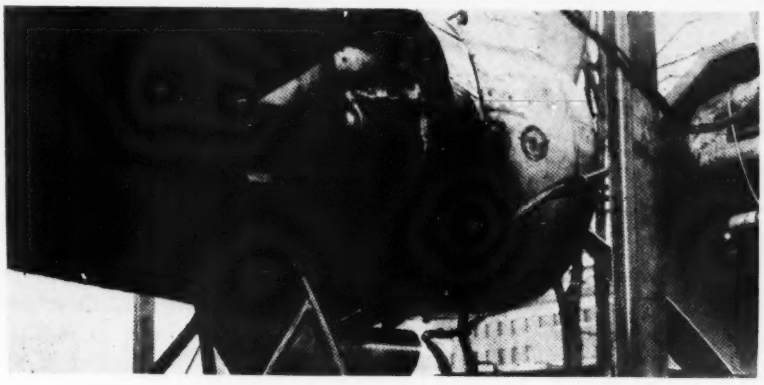


FIG. 7. Fire damage to aluminum-alloy cowl on DC-3.

Stainless Steel

Stainless steel should be used in all fire-resistant bulkheads such as fire walls and venturi cowls or diaphragms. This is essential in order to confine fires to the engine installation. Flames entering enclosed regions of the wing, which incorporate fuel tanks and lines, can be disastrous.

Stainless-steel tubing and fittings are necessary for piping inflammable fluids through the power-plant installation ahead of the main fire wall. Only tubing and fittings carrying flows of engine oil may be fabricated of aluminum alloy. Stainless-steel gasoline lines within the engine installation should be covered with heat-insulating material to prevent vapor lock, which can occur within 5 sec. after fire ignition.

Stainless-steel sheet, while not providing sufficient strength at high temperatures for use as primary structure, should be used for all cowling, nacelle skin, and wing skin within 18 in. of the nacelle. Although the stainless-steel skin will wrinkle and buckle when exposed to flame, it will remain in position, acting as a fire shield for other components. The single exception to the use of steel cowling is the N.A.C.A. engine ring cowl that can be fabricated of aluminum alloy. As fire cannot originate ahead of that cowl, only its inner surface can be exposed to flame. The outer surface, cooled by the air blast, removes heat from the cowl rapidly enough to prevent disintegration of the aluminum alloy. Within the installation proper smaller supports, clips, and brackets that are important to the control or functioning of the engine should be fabricated of steel.

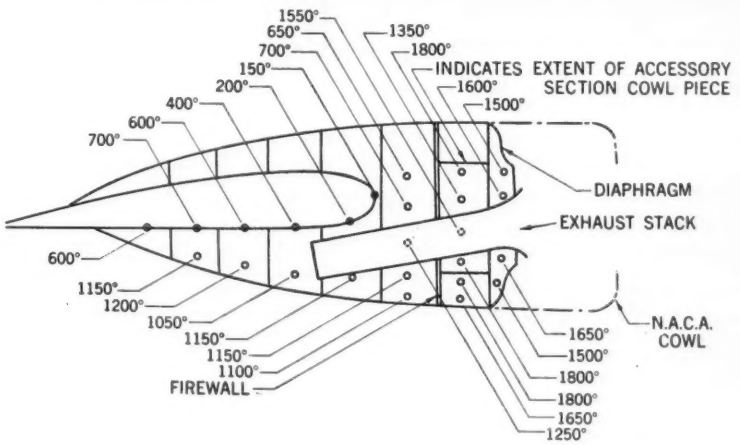


FIG. 8. Temperatures throughout DC-3 test unit during fires.

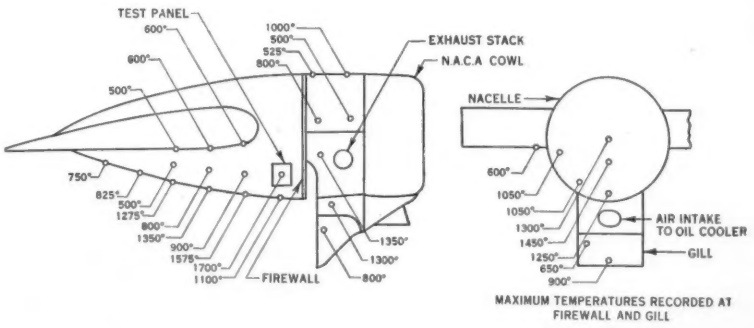


FIG. 9. Temperatures throughout CW-20 test unit during fires.

Hoses

As considerable work has already been done on fire-resistant hoses and hose connections, several different types have already been tested and approved by the Civil Aeronautics Administration. Hose connections that gave excellent service in the tests were standard AN neoprene types.

Tube Connections

Silver-soldered tube connections proved incapable of withstanding test fires and were replaced by mechanical connections of the flared, ferrule, and compression types. In general, soldered connections of any type should be avoided as much as possible.

The foregoing material requirements for the development of fire-resistant engine installations were demonstrated and substantiated during the fire test program. It is highly probable that materials and components not available for the tests already conducted will be considered for use in future engine installations. With this thought in mind, temperature surveys throughout the power-plant installations and nacelles were conducted to determine the temperatures that could exist at any point in the installations during fire. Figs. 8, 9, and 10 are sketches of the test units, showing the highest temperatures recorded at various locations. These figures should aid designers in determining proper placement of fire-resistant materials and components in and around the engine installation. In order to further aid the designer, the tests proved that materials and components for use in the power-plant installation proper may be evaluated for fire resistance by testing such parts in gasoline blowtorch flames of 2,000° to 2,200°F.

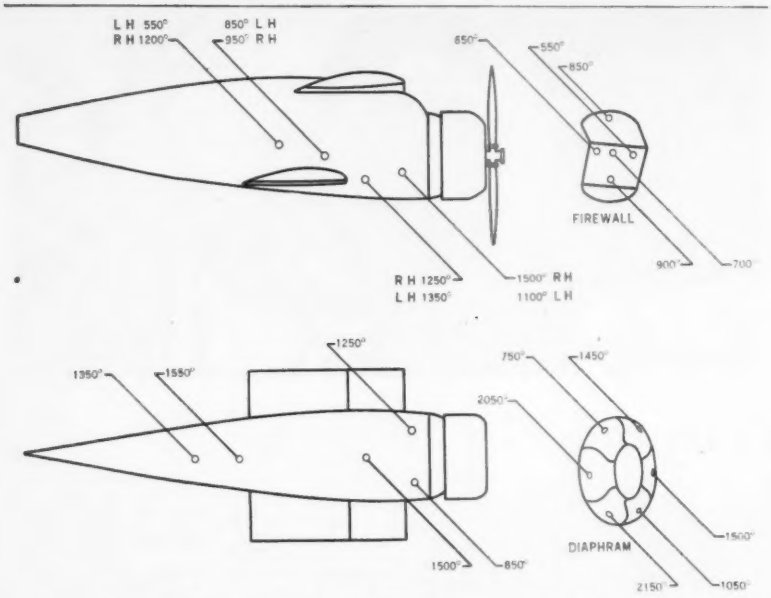


FIG. 10. Temperatures throughout Waco test unit during fires.

All components and materials of any engine installation should be carefully evaluated for fire resistance. It is obviously of little value to expend time and labor developing components capable of withstanding fires for periods of minutes and then mounting such components on a structure that disintegrates in a matter of seconds when exposed to the same fires.

DESIGN

As previously discussed under "Materials," the change from aluminum-alloy monocoque structures to welded steel tube structures is most important in developing fire-resistant installations. Welded steel tubes should be employed both as the nacelle supporting structure and as the structure within the nacelle.

Engine Exhaust Stacks

From the fire-ignition standpoint the proper placement of engine exhaust stacks is extremely important. In general, the exhaust stacks of present-day engine installations are located at the sides or the bottoms of the installations. In many instances the stack outlet is located in the vicinity of, and slightly downstream from, the outlet area of the power section. Such locations of exhaust stacks and stack outlets are extremely hazardous. Inflammable fluids—escaping from the engine or fluid systems in either the power or the accessory section, dropping through the section, and emerging from the lower regions of the installation—are likely to contact the hot exhaust stack or the hot exhaust gases at the stack outlet. The recommended exhaust-stack location is at the *top* of the installation with the exhaust stack extending back over the nacelle or wing and the stack outlet opening a reasonable distance behind the main fire wall. The only objection that has been raised to this design is that the view of exhaust flame frightens passengers, particularly at night. A sheet metal shield between the exhaust stack and the passengers should eliminate this unpleasant view, while the improved location of the exhaust stack will result in eliminating a serious fire source.

Carburetor Air Heating System

Another serious ignition source that exists on most present-day aircraft is the carburetor air heating system (see Fig. 11). These systems generally include muffs, shrouds, and baffles, in addition to mixing valves and chambers. In such systems, air heated when passing through the cylinders is trapped around hot parts of the exhaust system where it is further heated. From this region the hot air is led into the carburetor induction system through a mixing valve or escapes through an outlet duct to the air stream. Air heating systems of this type must be either well ventilated or vaportight. It is essential to prevent accumulations of oil vapor in these high temperature regions, for such vapors tend to ignite when the vapors reach the explosive range. This is a dangerous source of ignition of fire or of reignition after a fire has been extinguished. Vaporproof construction prevents accumulations of vapors by excluding vapor from the hot regions. Good ventilation prevents oil vapor that enters the heating system from attaining the explosive range at the prevailing high temperatures. As in the case of the exhaust stack, it is good practice to locate the carburetor air heating system at the top of the engine installation to ensure that inflammable fluids escaping from some engine or fluid system failure will drop away from the air heating system. It is also advantageous to locate the air inlets to these air heating systems as high as possible to prevent oil vapor from entering the system with the incoming air.

Ducts

In general, ducts to carburetors, coolers, superchargers, and similar equipment should be so located that no fluid, vapor, or flame can enter the systems. By locating the inlets to these systems

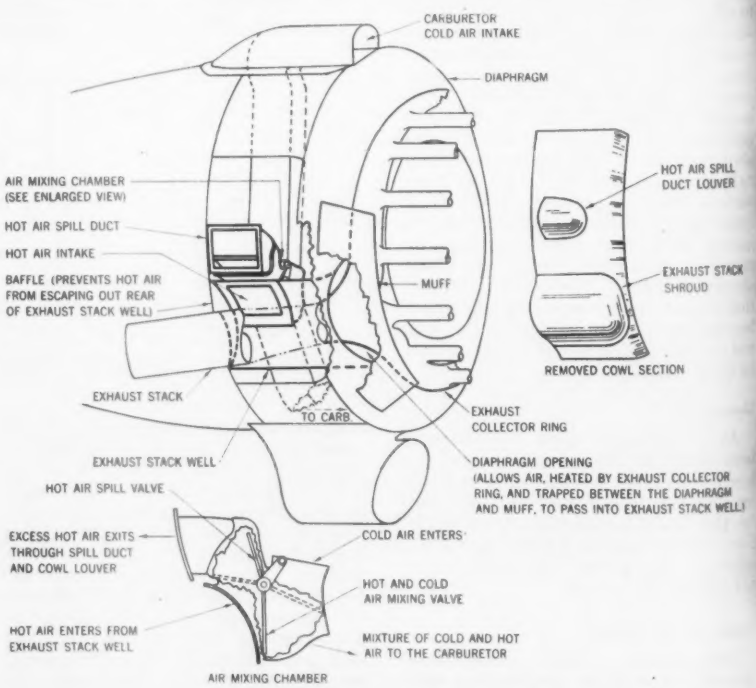


FIG. 11. DC-3 carburetor air heating system.

The B.F. Goodrich Airline of the month

DELTA AIR LINES

The first passenger air line across the "Deep South," Delta now serves a Southern and Middle Atlantic area extending from the Atlantic to Texas and as far north as Cincinnati, Ohio. Today, in addition to handling the largest volume of commercial traffic in the company's 20 year history, Delta is flying cargo, training personnel, and modifying warplanes for the U. S. Army and Navy.

Many B. F. Goodrich products fly over the Delta routes. Silvertown tires mean smoother, surer take-offs and landings; brakes equipped with B. F. Goodrich Expander Tubes give pilots excellent ground control; De-Icers add their big factor of flying safety.

To the more than 900 men and women who *are* Delta Air Lines goes this salute . . . our nomination of Delta for this month's "Airline of the Month."

In war or peace

B.F. Goodrich

FIRST IN RUBBER

New De-Icer improvements increase ice protection . . . provide longer life . . . save weight . . . cut maintenance costs!

The big assignment in our De-Icer laboratories has been to cut down weight, to increase aerodynamic efficiency, and to continue improvements in ice-removal effectiveness. In the new Type 11 De-Icer, a series of refinements have been developed which add up to better performance on all these counts.

FEATURES OF THE TYPE 11 DE-ICER

- **IMPROVED TEAR RESISTANCE:** Type 11 De-Icers have an all-surface ply of special elastic fabric which resists tearing.
- **THINNER AT ATTACHMENT:** This same all-over ply encloses the wire bead at the attachment edge, which results in a thinner cross section and permits better aerodynamic smoothness at the point of attachment.
- **NYLON TUBES:** The tubes which pulsate when the De-Icer is in action are made of a highly stretchable nylon fabric, and are recessed into the De-Icer to produce a smooth, uniform cross section.
- **LIGHTER:** Elimination of reinforcement strips and sponge filler, and more effective use of rubber and fabric, reduce the weight of the De-Icer.
- **BETTER ICE REMOVAL:** Improved tube arrangements, made practical by the stronger, lighter materials, provide more efficient ice protection.

TEST INSTALLATION of B. F. Goodrich Type 11 De-Icer on wing section. View shows first inflation of inboard tubes and second inflation of outboard section.

SMOOTHER SURFACE of new Type 11 De-Icer is the result of more uniform thickness. Tubes are recessed; tear-strips, sponge filler and fillets are eliminated.

HOW THE DE-ICER WORKS

The Type 11 De-Icer works on the same principle as other standard types. It consists of a rubber sheet, containing cells or tubes, stretched and mechanically attached at its outer margins to the leading edge surface to be protected. The inflation and deflation of the cells cracks the ice so that it is carried away by the air stream.

CUTAWAY shows construction features of Type 11 De-Icer. Note overall ply of elastic fabric and the way it encloses the wire bead. This results in a thinner cross-section at the point of attachment. The tubes are thinner, too—made of nylon and recessed to produce a smooth, uniform cross-section. Sponge filler, fillet strip, and fabric reinforcement strip have been eliminated.

- **LONGER LIFE:** The required tension is obtained with less stretching of the De-Icer over the leading edge. That means less strain on the rubber, and longer useful life for the De-Icer.

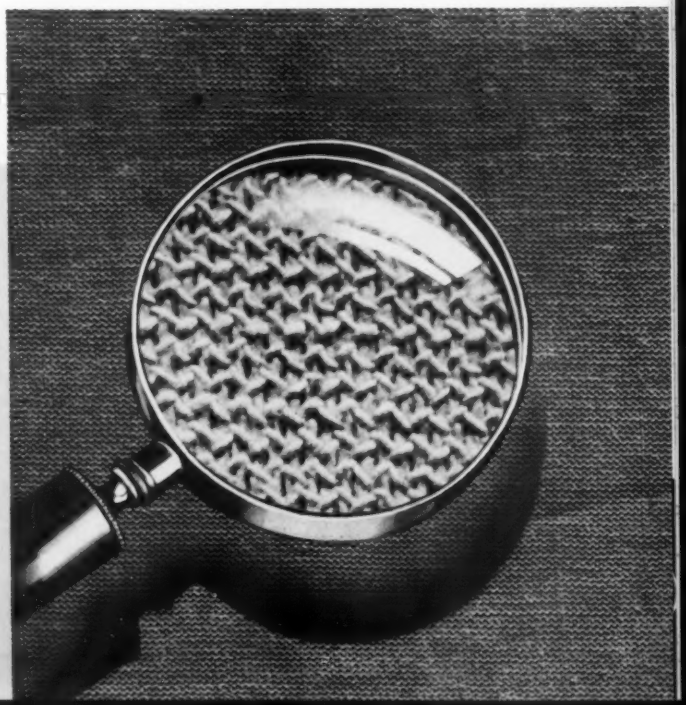
- **NO TRAPPED AIR:** The back of the new De-Icer is ribbed, forming spanwise channels between wing-skin and De-Icer. These channels guide any trapped air to chordwise channels and then to the vent holes. They also help to keep lubricating talc spread evenly under the surface.

- **REDUCED MAINTENANCE:** Most of the features mentioned here contribute to lower maintenance requirements, so that both repair time and costs are greatly reduced.

ARMY E NAVY
Awards to 9 plants

- **C. A. A. APPROVED** Type 11 De-Icers have been approved by CAA and Army Air Forces. The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.

ELASTIC FABRIC reinforces entire surface of Type 11 De-Icer. Special weave prevents lateral stretch. This fabric permits installation at lower tension than possible with all-rubber stretch area, increases tear-resistance, and greatly increases De-Icer life.



Skyway or Highway

B.F.Goodrich

FIRST IN RUBBER

B. F. Goodrich RIVNUTS excellent for plastic assemblies like this . . .

Here's just one of many uses for these simple, dual-purpose blind fasteners

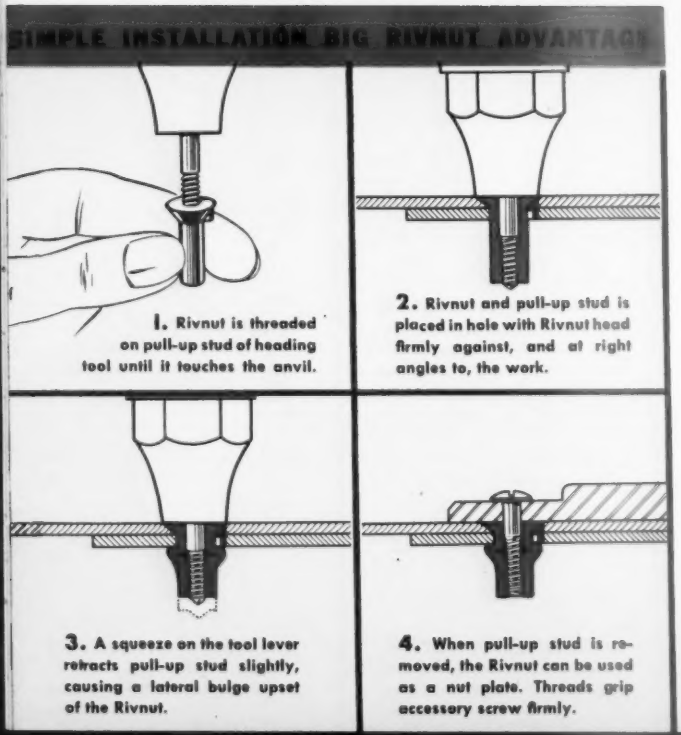
Rivnuts combine light weight with strength; simplicity of design with low cost; easy installation with efficient performance. All these qualities make them ideally suited for use as blind fasteners in this plastic ventilator assembly.

The many other advantages of B. F. Goodrich Rivnuts make their applications practically unlimited. They can be used as blind rivets, as nut plates for attachment, or both . . . in metal, plastics, or plywood. They have a wider bearing area than any other blind fastener, yet are compact and fit a smaller hole. And they're ready for use as received.

New splined aluminum Rivnuts are now available for application in plastics and wood. Brass Rivnuts are also available in standard sizes 6, 8 and 10.

Some typical applications of B. F. Goodrich Rivnuts

- Assembling cloth-covered wings, ailerons, rudders, etc.
- Fillets and fairing
- Door and window frames
- Access panels
- Flooring in airplane and on work platforms
- Wing panel closures
- Fastening bonding wires, clips, brackets, etc., for conduit
- Attachment of insulation
- Light frames
- Fastening fixtures to panel boards


SIMPLE INSTALLATION BIG RIVNUT ADVANTAGE
1. Rivnut is threaded on pull-up stud of heading tool until it touches the anvil.
2. Rivnut and pull-up stud is placed in hole with Rivnut head firmly against, and at right angles to, the work.
3. A squeeze on the tool lever retracts pull-up stud slightly, causing a lateral bulge upset of the Rivnut.
4. When pull-up stud is removed, the Rivnut can be used as a nut plate. Threads grip accessory screw firmly.

NEW FOLDER "RIVNUT DATA"

Perhaps there's a place in your operation for this unusual fastener. Write for your free copy of "Rivnut Data," which contains a complete picture story on installation, types, sizes and grip-ranges. Address The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.

B.F.Goodrich

RIVNUT

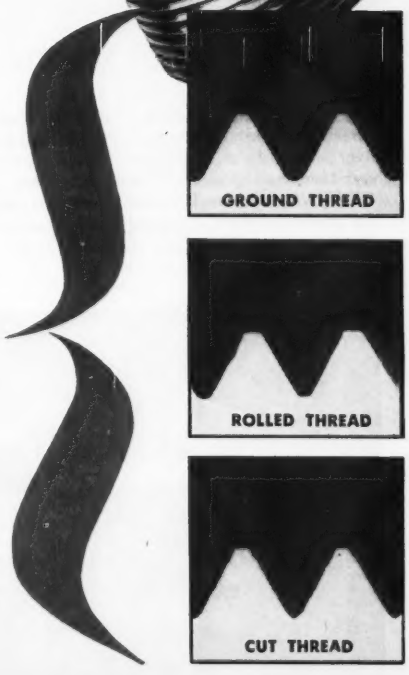
IT'S A RIVET...IT'S A NUT PLATE

How to hang a wing by a thread—*Safely*

SHOULDERING loads of tension and shear in the *thousands of pounds*—not just for a moment, *but for the life of the aircraft*—is as rugged a test of bolt strength as you will find. Yet that's exactly the job Thompson Bolts perform today as main wing-attaching bolts—and on many another tough assignment where a never-failing hold under load is required!

One reason Thompson Bolts are specified for jobs where no ordinary bolt is safe is the unusual amount of precision workmanship that goes into them from the rough hot-forged blank to the final exacting inspection. Take threads, for example. Thompson has found that—for aircraft use—*ground* threads offer outstanding advantages over other methods. Consequently, every tension Bolt manufactured by Thompson has a thread ground concentric with the shank and area under the head. Produced in the latest type of automatic grinding equipment this ground thread has a smoothness, accuracy and fit *seldom matched in precision by any similar product and far stronger to safely handle heavy loads!* Moreover, the thread is ground *after* heat treatment and *after* preliminary grinding performed to remove decarburization . . . two additional important safeguards against thread failure on any job.

But that's only a part of the interesting story of the highly-developed processes used by Thompson in producing Aircraft Bolts in a range of sizes and types (including those to NAS standards) suited to *all* kinds of applications on aircraft. If yours is a problem involving a bolt connection, write our engineering department for assistance either in designing or recommending a Bolt for your needs. Ask for the 16-page Brochure illustrating and describing Thompson manufacturing methods and products in detail. Address Thompson Products, Inc., WEST COAST PLANT, Bell, California.



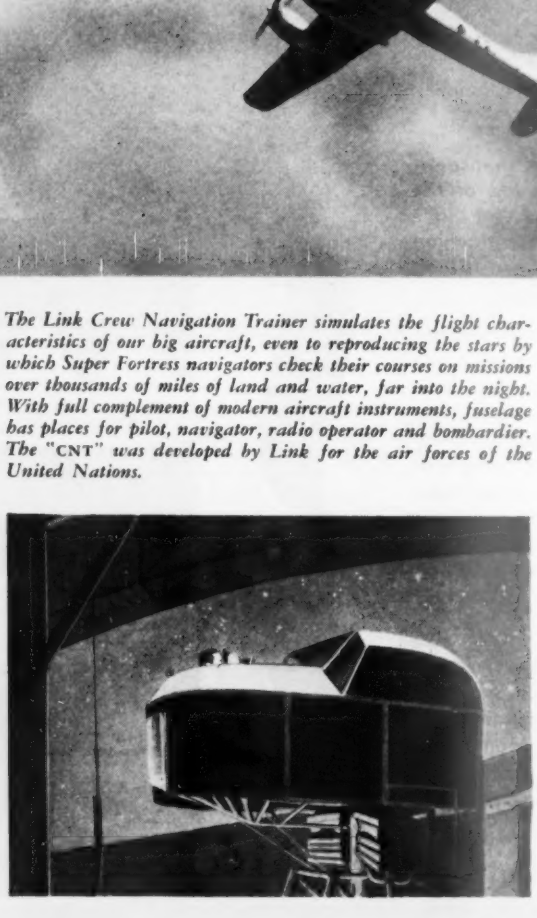
ARMY E NAVY

Thompson Products, Inc.

WEST COAST PLANT ★ BELL, CALIFORNIA

How we hit *Sasebo* on the nose

The Link Crew Navigation Trainer simulates the flight characteristics of our big aircraft, even to reproducing the stars by which Super Fortress navigators check their courses on missions over thousands of miles of land and water, far into the night. With full complement of modern aircraft instruments, fuselage has places for pilot, navigator, radio operator and bombardier. The "CNT" was developed by Link for the air forces of the United Nations.



THE LONG-GUARDED secrecy of Sasebo, important base since 1886 of the Japanese Imperial Navy, was rudely shattered July 7, 1944. At dusk on that day, there suddenly appeared in the sky above Sasebo a strong formation of American bombers. From each plane, in quick succession, hurtled tons of demolition and incendiary bombs.

Great Boeing Super Fortresses "hit Sasebo on the nose" after flying from Chinese bases, well over 1,000 miles away. Yawata and Omura war industries were also visited, destructively. All the American planes came home.

This historic flight was a marvel of preparation and navigation. Such missions, which involve exacting problems of navigation, are well rehearsed long before takeoff, in the Link Crew Navigation Trainer on the ground.

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BINGHAMTON, NEW YORK, U. S. A.

LINK MANUFACTURING COMPANY, LTD., GANANOQUE, ONTARIO, CANADA
Link Trainers, Aviation Sextants, and other products contributing to the safety of flight
WHEN WRITING YOUR SERVICE MAN, USE V-MAIL—IT GOES BY AIR

as far forward as possible, the chance of fluid, vapor, or flame entering the inlets is considerably decreased. Ducts should be fabricated of heat-resistant materials, since the penetration of fire through a duct can be a greater hazard than the entrance of fire through the normal inlet.

Shut-Off Valves

Shut-off valves, operated from the cockpit, should be incorporated in all systems involving the passage of inflammable fluids through the engine installation. This is most important in any airplane because the stoppage of flow of an inflammable fluid during a fire in flight may mean the difference between a successful fire extinguishment and the destruction of an airplane. These valves should be located behind the main fire wall or, if this is impossible, at the fluid supply tank.

Drainage and Ventilation

Regions of the airplane in close proximity to the engine installation but separated from the installation by a fire wall should be well drained and ventilated. Such regions as wheel wells, wing compartment, and tank compartments may contain inflammable fluids or vapors because of the possibility of leakage of contained parts of the fluid systems. Ordinarily such leakage may not be hazardous, but, in the event of an engine fire, the temperatures of the near-by regions may be high enough to ignite or cause the explosion of these vapors with disastrous results. Proper drainage and ventilation preclude the accumulation of vapors in regions close to the engine installation.

Rubber Parts

Rubber engine-mount bushings should be protected from flame by metal shields. Under these circumstances, rubber bushings, when subjected to power-plant fires, bake and become hard and brittle but remain intact. However, it is good practice to design the engine support so that loss of the rubber bushings will not result in loss of the engine.

Tests proved that landing-gear tires can be ignited and seriously damaged by power-plant fires. In order to protect the tires, the landing gear should retract into the nacelle and should be protected in the retracted position by tightly closing bays, which will prevent the fire from reaching the tire. A good example of a wheel properly submerged in the nacelle and covered is the landing-gear arrangement of the CW-20 airplane.

In aircraft in which the wheels, when retracted, are not fully submerged in the nacelle, it may be necessary to lower the landing gear in the event of fire to remove the tire from the flame path. The landing gear of the DC-3 airplane is a good example of this type.

An engine installation that is intended to be fire resistant must be as clean as possible aerodynamically. Clean aerodynamic design is essential within the engine installation as well as on the outside surface of the cowling. Elimination of cracks, ripples, protuberances, and pockets removes areas where fire might cling regardless of high air blast or extinguishing agent.

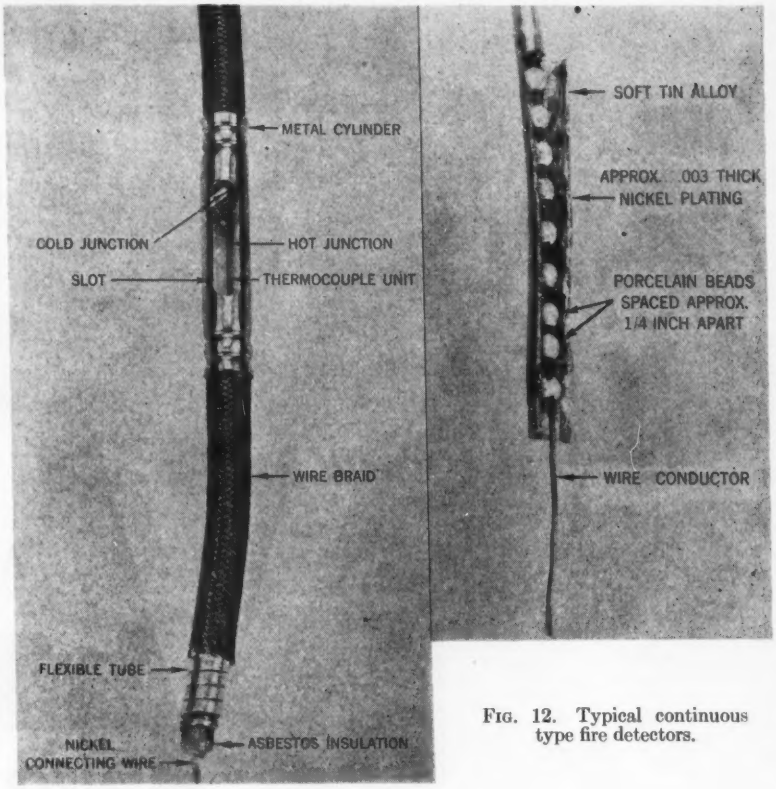


FIG. 12. Typical continuous type fire detectors.

FIRE DETECTORS

Fire detectors should be incorporated in *all* aircraft engine installations, for it is essential that pilots be warned of fire as soon as possible. Modern tightly cowled engines can catch fire with little chance of the pilot's observing the fire in its early stages. There is one case on record in which a power-plant fire occurred during a night flight. The pilot was unaware of trouble until the fire had so damaged the engine supporting structure that the engine dropped from the airplane. Although malfunctioning of the engine occurs before and during many power-plant fires and, in a sense, gives some warning of trouble to the pilot, this engine malfunctioning cannot be relied upon as a fire detector.

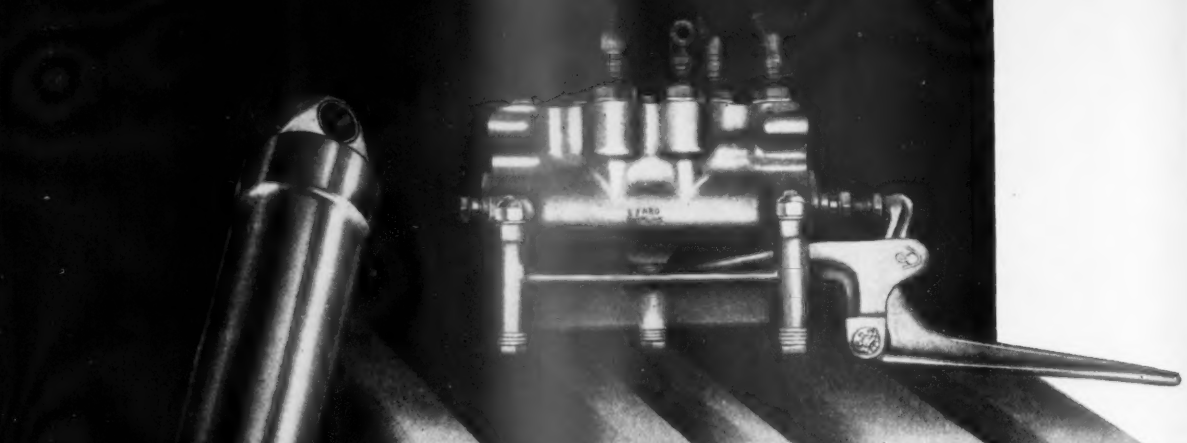
Detectors for use in aircraft-engine installations may operate on any one of a number of principles, including direct or differential expansion of metals, expansion of fluids, fusing of metals, burning of combustible materials, rate of temperature rise (thermocouples), and electronic circuits that employ the electrical conducting or rectifying properties of flames.

All these detectors may be classified under two general types. The first type, the continuous detector, is in the form of a wire or tube capable of detecting fire anywhere along its length (see Fig. 12). The second type, the unit detector, is, as the name implies, a small unit capable of detecting flame in the immediate vicinity of the detector.

A continuous detector may be considered as a great number of unit detectors closely connected in series. Of the two general types, the continuous detector is superior to the unit detector for use in engine installations.

Location and Spacing

It is obvious that the locations of all fire sources in an engine installation cannot be predicted. Therefore, it is necessary to locate detectors in areas through which flame will pass regardless of the location of the source. In the tests, these zones proved to be the air outlet areas of the power and accessory sections (see Figs. 13 and 15). In exceptionally large volumes, such as in the CW-20 type installation where the power and accessory sections are combined into one large region, it is necessary to provide detectors in a central region of airflow to detect small fires that might not reach the air outlet of the region for some time (see Fig. 14). In general, it is a simple matter to locate continuous detectors in air-outlet areas so that complete coverage exists. However, in order to ensure that flame will not pass between unit detectors without operating at least one detector, it is necessary to conduct fire tests. The spacing of unit detectors is difficult to predict. Both unit and continuous detectors should be installed 1 or 2 in. away from supporting surfaces to ensure



VARD

AIRCRAFT HYDRAULICS

For every aircraft hydraulic unit made to proprietary design, there are two made to airframe manufacturers' design.

Although we do considerable design work, we frequently manufacture units which have been completely designed and detailed by the plane builder.

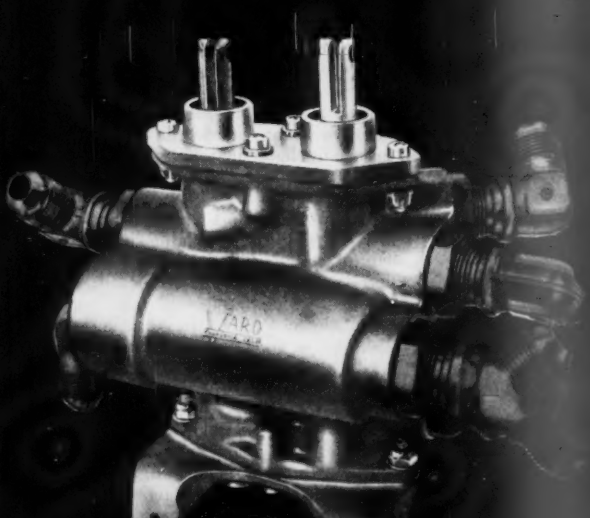
Illustrated here, are three aircraft hydraulic units; an engine cowl flap cylinder and two automatic control valves. Each of these units was wholly designed by the plane builder. We have produced large quantities of these units on extremely short schedules.

The control valves have permanent moulded aluminum bodies. The cylinder has a forged aluminum cap. Pistons and sleeves are precision ground and lapped to fits of .0002-in. The completed units operate on 1500 p.s.i. pressure system.

We can make hydraulic units complete from casting to smallest machined part.

We employ only the most advanced production methods and our test equipment will meet the latest hydraulic testing specifications.

A VARD-built hydraulic unit will meet the specifications.



VARD INC. • PASADENA 8, CALIF.

that the detector is enveloped in flame.

Fire detectors must be unaffected by all conditions existing in aircraft-engine installations, such as exposure to gasoline, oil, grease, dirt, and water. In addition, detectors must not be affected by vibration or fatigue. However, in the event of fire, the detector must operate in a rapid and positive manner, even after continuous exposure to these conditions. The materials used in fabricating detectors should withstand temperatures of 2,000° to 2,200°F. for at least as long a time as is required for the detector to operate.

Every precaution must be taken against the possibility of the detector giving a false alarm. Detector operating temperatures should be 50° to 100°F. higher than the maximum possible ambient temperature of the region in which the detector is located. Detecting circuits should be so designed that, in the event of detector failure, the detector will become inoperable rather than cause a false alarm. In addition, all detectors should incorporate supervisory systems that will ensure that the airplane crew is advised at all times as to the integrity of the detecting system.

For adequate protection, any detector should turn in a warning within 3 sec. of the start of a fire.

Fire extinguishing systems will be discussed briefly in the next part of this paper. The same general discussion will serve for all engine installations in aircraft now in the design stage, as well as in aircraft already in service.

Engine Fire Protection for Aircraft in Service

For adequate fire protection of engine installations of aircraft already in service, as many as possible of the changes previously discussed should be made. In addition, it is necessary to incorporate a complete extinguishing system capable of extinguishing the most severe fire rapidly and completely.

Fire Extinguishing Systems

The fire extinguishing tests were conducted primarily to provide complete extinguishing systems for aircraft in general use in which fire resistance was not considered in the original design. Therefore, the fire conditions were made as severe as possible so that the protective system developed would be adequate. Because of the great number of variables involved in these tests, it is impossible to discuss the test results in detail in a paper of this type. In addition, these test results have already been completely described and analyzed in references 11 and 12. Accordingly, the following discussion will be of a general nature.

A complete extinguishing system protects all potential fire zones on the engine side of the main fire wall. Potential fire zones may be described as those regions of an installation that include

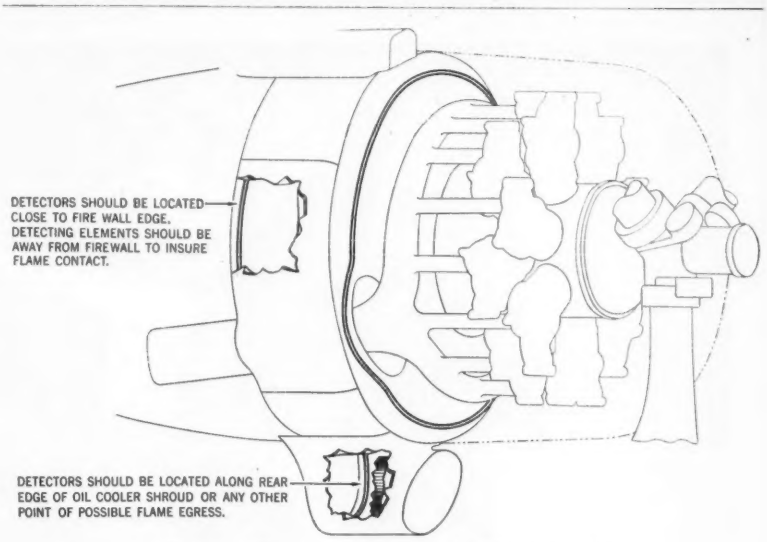

DETECTORS SHOULD BE LOCATED CLOSE TO FIRE WALL EDGE. DETECTING ELEMENTS SHOULD BE AWAY FROM FIREWALL TO INSURE FLAME CONTACT.
DETECTORS SHOULD BE LOCATED ALONG REAR EDGE OF OIL COOLER SHROUD OR ANY OTHER POINT OF POSSIBLE FLAME EGRESS.

Fig. 13. Fire-detector locations in DC-3 test unit.

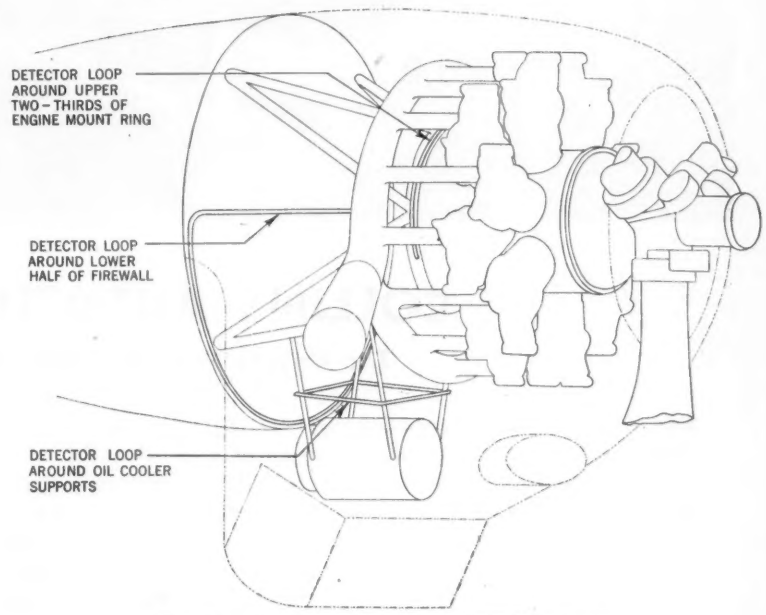

DETECTOR LOOP AROUND UPPER TWO-THIRDS OF ENGINE MOUNT RING
DETECTOR LOOP AROUND LOWER HALF OF FIREWALL
DETECTOR LOOP AROUND OIL COOLER SUPPORTS

Fig. 14. Fire-detector locations in CW-20 test unit.

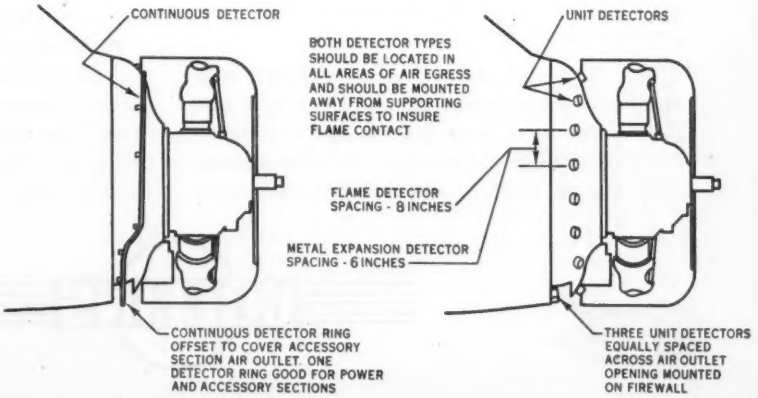

CONTINUOUS DETECTOR
UNIT DETECTORS
BOTH DETECTOR TYPES SHOULD BE LOCATED IN ALL AREAS OF AIR EGRESS AND SHOULD BE MOUNTED AWAY FROM SUPPORTING SURFACES TO INSURE FLAME CONTACT
FLAME DETECTOR SPACING - 8 INCHES
METAL EXPANSION DETECTOR SPACING - 6 INCHES
CONTINUOUS DETECTOR RING OFFSET TO COVER ACCESSORY SECTION AIR OUTLET. ONE DETECTOR RING GOOD FOR POWER AND ACCESSORY SECTIONS
THREE UNIT DETECTORS EQUALLY SPACED ACROSS AIR OUTLET OPENING MOUNTED ON FIREWALL

Fig. 15. Fire-detector locations in Waco test unit.

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The Key to Precision Control

THE Autotune was conceived and engineered by Collins many years ago. It was the result of a growing dissatisfaction with slow, haphazard methods of tuning radio equipment and a persistent effort to improve them.

What is it? How does it work?

The Collins Autotune head shown above is a mechanical device for turning a control shaft and stopping it precisely at any one of several pre-determined positions.

The Collins Autotune system consists of a number of Autotune heads, all driven by a single electric motor, each quickly and simultaneously repositioning a separate and non-interrelated tuning shaft to new settings chosen in advance by the operator. At the touch of a button or flip of a dial, the Collins transmitter or receiver is thus completely and exactly tuned to the wanted channel in a matter of seconds.

Collins communications equipment, Autotune controlled, was adopted by American Airlines, Braniff Airways, Tropical Radio Telegraph Co. and others long before the war. Reliability has been demonstrated through the years under all service conditions.

The Collins transmitter design and the Autotune have proved so advantageous to the Armed Services that military authorities have requested other large companies, in addition to Collins, to build them. The Collins Radio Company, Cedar Rapids, Iowa.

ARMY E NAVY

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*U. S. Patents issued and pending.

parts of inflammable fluid systems and ignition sources, zones into which burning fluids or vapors may enter or penetrate through materials of low fire resistance, and the carburetor air induction system. Each such zone should be individually protected against fire, and the extinguishing agent should be released in all regions simultaneously.

Fire entrained in high air blasts, such as the air blast that passes through the power section of a radial engine, can only be extinguished by an extinguishing agent cutting across the blast with great force, forming a sheet of agent that cuts the fire away from the source. This sheet of agent must extend completely across the region and can only be produced by an agent applied at a high rate and distributed equally throughout the region.

In regions of little airflow, the rate of agent application and equality of distribution are not critical. It is only necessary to apply sufficient agent around the region to smother fires occurring in these regions.

Action of Extinguishing Agents

Extinguishing agents combat fire by four different actions, three of which are essential for extinguishing aircraft power-plant fires. *Mechanical action*, which results from directing an extinguishing agent across the fire with sufficient force to cut the flame away from the fuel, is of primary importance in extinguishing fires in regions of high air blast. *Smothering action*, which renders air feeding fire incapable of supporting combustion, is most effective in regions of little airflow. *Blanketing action*, which prevents air from reaching fire, was most important in extinguishing itinerant "fire tails" outside the engine installation proper. *Cooling action* is of little value in extinguishing power-plant fires because of the small quantities of agents necessarily used.

Of the extinguishing agents tested, which included methyl bromide, carbon tetrachloride, carbon dioxide, Karbaloy, Dugas, and many combinations of those agents, methyl bromide proved superior to all others in extinguishing aircraft power-plant fires.

Extinguishing agents should be released in all protected regions of the engine installation simultaneously, and the proper rate of agent application to each region should be maintained for a period of at least 2 sec. It is emphasized that if proper rate and duration of extinguishing agent discharge and proper distribution systems are not employed the chances of extinguishing fires of any size are remote.

Procedure

The procedure followed in the event of fire is also extremely essential. For aircraft already in service to which extinguishing systems are added, it may be necessary to provide placard information for the pilot's use in the event of fire in flight. The sequence may vary in different airplanes, but the following steps should be taken as soon as a fire is detected:

(1) Open air inlets to oil cooler, intercoolers, etc.

(2) Open all flaps or gills regulating air flow through the engine installation.

(3) Cut off flows of inflammable fluids through the engine installation.

(4) Feather propeller.

(5) Cut engine ignition switch.

(6) Set extinguishing agent selector valve to burning engine.

(7) Release extinguishing agent.

(8) *Do not start engine again.*

All these steps are important to ensure extinguishment and to prevent a second fire from igniting as soon as the first fire is extinguished. No engine should ever be started after an engine fire has been extinguished until the source of the fire has been determined and eliminated.

Automatic Systems

Many automatic systems have been designed which are operated by the action of a fire detector. These systems ensure that the proper procedure is taken, as discussed previously. However, it is believed that incorporation of an automatic system, which would shut down an engine when operated by a fire detector, would deprive the pilot of proper control. Therefore, a semiautomatic system is recommended. In this system, in the event of a power-plant fire, the detector would operate a pilot warning device. At this point, the pilot would choose his course of action. He might prefer to continue taking power from a burning engine in order to clear some obstruction during take-off, thereby delaying the extinguishing of the fire a short time.

This automatic system would make provisions for performing all the necessary actions preliminary to releasing the extinguishing agent and, at the proper time, would release the agent.

Other automatic devices that have been suggested are the crash or inertia switch and the overturn switch. Both of these devices are incorporated in foreign aircraft. These switches provide for automatic release of extinguishing agent in aircraft-engine installations in the event of a crash landing or ground loop. Tests of such equipment have never been incorporated in the fire test program because of the great number of variables involved. However, it is believed that the release of extinguishing agent in and around the engine installation in the event of a bad landing must provide some degree of protection and therefore seems logical.

Conclusions

(1) Aircraft in the design stage should incorporate welded steel tube rather than aluminum-alloy monocoque structures in and around engine nacelles.

(2) Stainless steel should be used throughout engine nacelles to replace aluminum alloy in cowling, skin, tubing, ducts, fire walls, and important brackets and clips.

(3) Fire sources, such as carburetor air heating systems and exhaust stacks, should be designed to minimize the hazards involved and should be located at the top of the installation.

(4) Shut-off valves, operable from the cockpit, should be included in all inflammable fluid systems passing through the engine installation.

(5) Rugged and quick-acting fire detectors should be installed in the engine installations of all aircraft.

(6) Power-plant installations in service should incorporate as many changes as possible to increase the resistance to fire and to minimize the possibility of fire ignition.

(7) Complete extinguishing systems should be installed in engine installations in which fire resistance was not considered in the original design. In fire-resistant installations the amount of extinguishing agent possibly may be reduced.

(8) Semiautomatic extinguishing systems are desirable in all aircraft. The use of such systems ensures that the pilot will maintain complete control of the airplane, which is not the case when a full automatic system is used.

(9) Crash and overturn switches that will release an extinguishing agent in the engine installation in the event of bad landings are believed desirable.

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[11] *Determination of Means to Safeguard Aircraft from Powerplant Fires in Flight*, Technical Development Report: Part I, TD Report No. 33 (DC-3 tests); Part II, TD Report No. 37 (CW-20 tests); Part III, TD Report No. 38 (Waco YKS-37 tests).

[12] *Design Recommendations for Fire Protection of Aircraft Powerplant Installations*, Technical Development Note No. 31.

then he thought to himself

"WHY WAIT 'TIL YOU'RE CORNERED?"

AT his recent reception in Washington, General DeGaulle and General Pershing were deploring the havoc of the war and hoping some good might result. DeGaulle remarked that perhaps Mahomet had something when he ventured the statement:

"Without war, the world would be in a condition of stagnation."

It is a sad commentary on human inertia that men must wait until the gun is jabbed in their ribs before they will stir themselves to great effort.

But it seems a fact that men usually wait for a crisis before they get bold and take hurried recourse to the best means for liberation.

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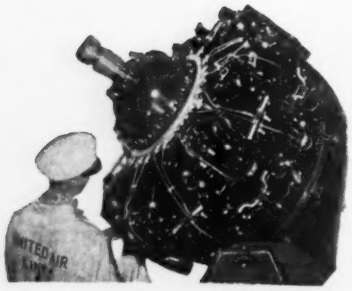

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Demagnetization During Magnetic Particle Inspection

M. L. MAGES*

Magnaflux Corporation

SUMMARY

Demagnetization between the circular and longitudinal magnetizing operations of the Magnaflux inspection method has hitherto been thought necessary and is the practice in many plants, particularly in the aircraft field. This necessitates the use of extra man-hours and equipment. The results of an investigation are given which show that a demagnetizing step between the magnetizing operations is not only unnecessary but undesirable.

INTRODUCTION

THE MAGNAFLUX PROCESS has now become a standard procedure for rapid, nondestructive testing of ferromagnetic parts where it is essential to detect any cracks or inclusions that may result in a direct failure or future fatigue failure of the part. An important application of the method is in the inspection of aircraft parts to detect flaws in such components as engine cylinders, piston rods, crankshafts, propellers, engine mounts, and landing gear. It is also widely used for inspection of gun mounts, turbine blading, high-pressure piping, and all types of welded structures—in short, for any ferromagnetic parts that have been subjected to high stress, as in heat-treatment or fabrication, or are to be subjected to high stresses as a function of their normal operation.

As a result of its wide application and importance to the war effort, the method has been standardized, and specifications have been established by the Army and Navy for the exact procedure and type of equipment to be used in testing critical parts so that uniformity and maximum effectiveness of the method may be attained. These specifications have been carefully drawn on the basis of known results and theoretical considerations. It is only natural, however, that as research work goes on and experimental data accumulate improvements will be developed in the technique and the machines used to apply the method. A recent development of experimental work indicates that one of the steps of the Magnaflux process—the process of demagnetization, now required between directional current magnetizations—may be omitted without loss of effectiveness, which, of course, means that the time required to test a large number of parts can be substantially reduced. In this article the results that led to this conclusion are presented.

Presented at the Aircraft Production Session, Twelfth Annual Meeting, I.A.S., New York, January 25–27, 1944.

* Head of Electrical Research Department.

THE MAGNAFLUX METHOD

A brief outline of the Magnaflux method will serve to explain the principle of operation and some of the terminology connected with the procedure.

The testing of iron or steel by the Magnaflux method consists essentially of magnetizing the part under test by means of a coil or by passing current directly through the part and applying an indicating medium, which may be a suspension of finely divided magnetic material in a light oil.

If there is a crack or discontinuity in the material, the magnetic leakage field formed across the crack will attract the magnetic particles suspended in the oil, and an outline of the crack, greatly magnified, will be formed. If the indicating medium is applied while the parts are being magnetized, the process is called the "continuous" method. When the indicator is applied after the parts have been magnetized, the process is called the "residual" method.

METHODS OF MAGNETIZATION

It will be noted that two ways of magnetizing the part were mentioned above—that is, by means of a magnetizing coil and by passing current directly through the part. The reason for differentiating between the two types is that each type of magnetization is most effective for a particular direction of the defect. Magnetization by passing current through the test part along its axis, known as "circular" magnetization, establishes an effective leakage field to detect cracks running lengthwise of the part, such as a seam. Coil magnetization, or "longitudinal" magnetization, establishes a field that brings out defects transverse to the axis of the part. For certain production parts where by experience only one particular type of crack is expected to be found, it is sufficient to use only one magnetization of the proper type, but for most parts both circular and longitudinal magnetization are necessary for a complete test. In the latter case the test procedure would then be as follows:

Magnetize in one direction—inspect—demagnetize; magnetize in other direction—inspect—demagnetize (final)—rinse. It is the step of demagnetization between circular and longitudinal demagnetization, or between longitu-

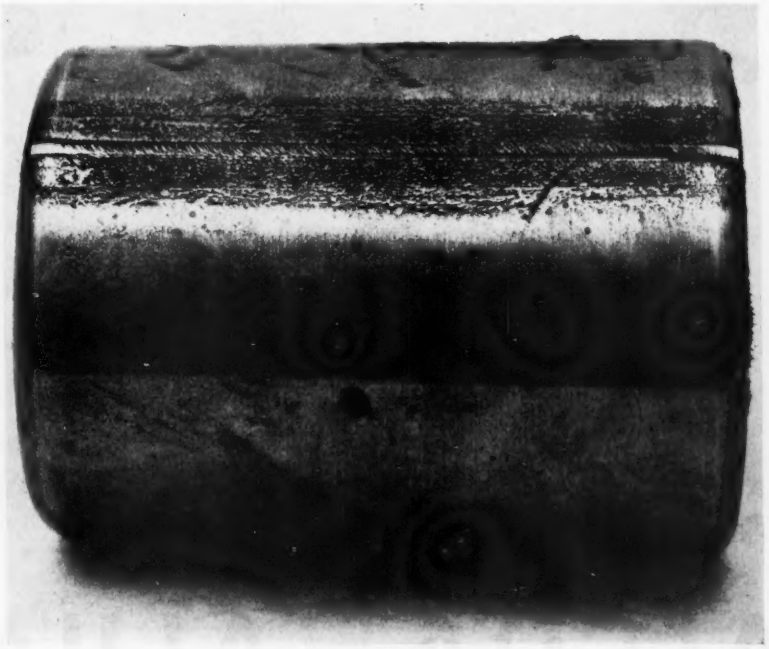

FIG. 1.

88,000 pounds per sq. in. tensile strength in extruded shapes, 75,000 pounds in alclad sheet—stronger than any aluminum alloy in use today—nearly two times the yield strength of ordinary structural steel and one and one-third times the tensile strength. That's Alcoa's new high strength alloy, 75S.

No untried youngster, this alloy. Alcoa's research and development divisions have spent years in testing the performance of experimental quantities. In the fall of 1943, the first commercial run was put through Alcoa mills, and production has continued at an ever-increasing pace. Already, at least eight major aircraft companies are building new experimental planes in which 75S is the principal structural material.

75S is now a standard alloy for alclad sheet and extruded shapes. Plain sheet, plate, rolled rod and bar made from 75S continue on an experimental basis, but may be obtained for certain projects.

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dinal and circular magnetization if that order is used, about which we are here concerned. For the demagnetization step to be eliminated we must be certain that the effectiveness of the second magnetization in finding flaws will not be decreased by the premagnetized condition of the part.

Successive Circular and Longitudinal Magnetization

It would seem plausible that, to change the configuration of the flux lines from a circular path to a longitudinal path, a greater magnetic force would have to be applied than if the molecular magnets had a random distribution to start with, as they do when the part is unmagnetized. On the other hand, consideration of ordinary coil magnetization does not support this conclusion. Assume that a part is magnetized longitudinally in a coil to some value below saturation and is then remagnetized in the reverse direction by reversing the part in the coil without changing the strength of the magnetizing field. Here we have a condition where the molecular magnets are strongly lined up end-to-end and where it definitely would be expected that resistance would be offered to changing the configuration. Yet, by applying the same magnetizing force in the opposite direction, the part is completely reversed in magnetism and is fully as strong, or very nearly equal, in magnetic strength to the original field. The same phenomenon holds in reversing a circular field. It is not surprising, therefore, that when we change the configuration of the molecular magnets from circular to longitudinal, the longitudinal field will produce its full effect just as if the part were unmagnetized to start with.

Tapered Bearing Tests

When a part is magnetized successively by a circular and a longitudinal field, the resultant is a field at some angle to the axis. In Fig. 1 is shown a magnetograph of the resultant field in a tapered bearing after it was magnetized —first, circularly and then longitudinally. It is seen that the resultant field across the slot is slanted. The angle of slant depends on the relative strengths of the two magnetizing components. At the ends of the slot the longitudinal field departs from a direction parallel to the axis and alters the resultant accordingly.

Piston Pin Tests

The next procedure was to take measurements of the external field of several parts magnetized longitudinally—first, starting from the unmagnetized condition and, second, from a circularly magnetized condition. With the longitudinal magnetizing force kept constant, any change in the longitudinal leakage field due to the previous circular magnetization should be evident in the flux indicator readings as the circular component has no external leakage field. It was found that the external longitudinal field not only was equal under both conditions but was actually stronger for some test parts when the part had previously been circularly magnetized. This is shown by the data of Table 1, which were taken for an aircraft piston pin.

Table 1

Coil Magnetization (Amp. Turns)	With Coil Alone	250-Amp. Circular Plus Coil	1,500-Amp. Circular Plus Coil	4,100-Amp. Circular Plus Coil
1,600	2.0	4.2	3.7	4.0
2,400	3.0	5.3	5.0	5.0
3,000	4.2	7.8	7.2	6.5
4,800	7.5	8.0	11.0	11.0
7,200	11.7	17.0	18.0	15.5
10,400	20.5	22.0	24.0	23.5

Table 2

Coil Magnetization (Amp. Turns)	With Coil Alone	250-Amp. Circular Plus Coil	1,500-Amp. Circular Plus Coil	4,100-Amp. Circular Plus Coil
1,600	2.0	2.0	4.0	3.8
2,400	3.0	3.0	4.0	4.0
3,000	3.7	3.7	5.5	5.2
4,800	6.5	7.2	8.8	9.7
7,200	12.0	13.0	12.5	13.5
10,400	18.5	19.0	19.5	19.5

This table shows the external field strength of an aircraft piston pin under various conditions of magnetization by a coil alone and by a successive magnetization of circular and longitudinal fields. For example, taking the first line we see that the piston pin became magnetized to a strength of 2.0 units when magnetized in a coil of 1,600-amp. turns, then to a field strength of 4.2 units when circularly magnetized with 250 amp. and with the 1,600-amp. turn coil; then to a field strength of 3.7 units with 1,500-amp. circular and the 1,600-amp. turn coil; and, finally, to 4.0 units with 4,100-amp. circular magnetization and the 1,600-amp. turn coil. While the data is not entirely consistent, the results show there is no doubt that, as far as the external field is concerned, this part becomes more strongly magnetized if magnetized in the two directions (circular and longitudinal) successively than if it is magnetized longitudinally alone. Other parts when magnetized did not always show a superiority for the double magnetization, but they never fell below the magnetization acquired through a single longitudinal or coil magnetization.

Shear Blade Tests

A similar test for a broken portion of a shear blade is shown in Table 2. Since this was a solid part, circular magnetization was obtained by sending a current

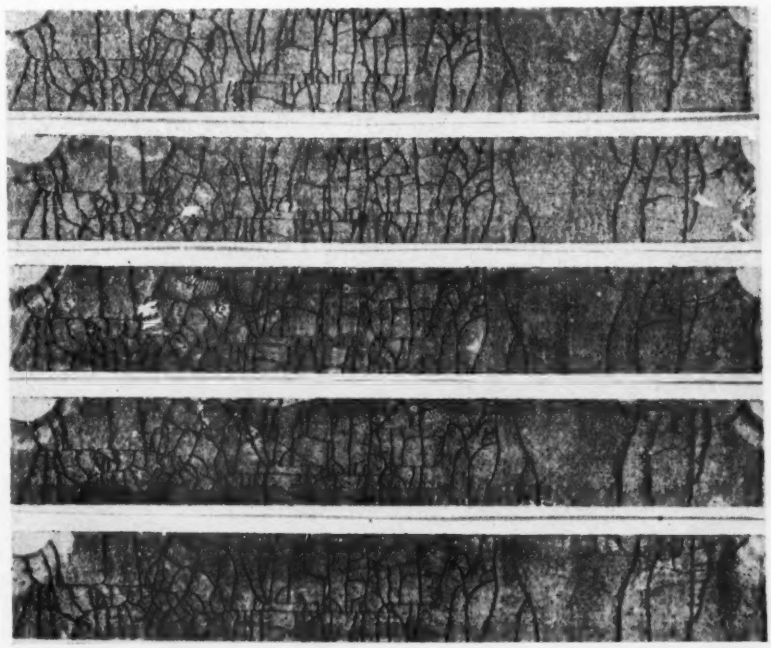

Fig. 2. Reading from top to bottom, the five amperages used were 230, 300, 400, 600, and 950.

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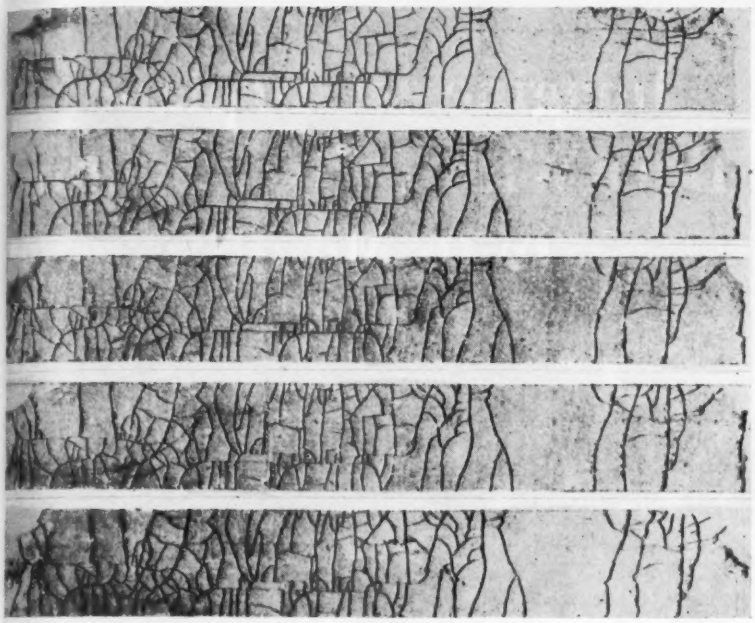


FIG. 3. Effect of coil magnetization on indications brought out by 5,000-amp. circular magnetization. In the usual order, the following magnitudes of coil magnetization were used: 230, 300, 400, 600, 950.

directly through the part. In the case of the piston pin, a copper rod was used for circular magnetization.

This part also shows an increase in the external field strength for the condition of circular magnetization followed by coil magnetization. Evidently nothing is lost by double magnetization over single magnetization.

It was stated in a previous paragraph that reversing the longitudinal magnetism in a part with the strength of the magnetizing coil held constant does not have any weakening effect, or has slight effect, on the final magnetization. One such test gave the figures shown in Table 3.

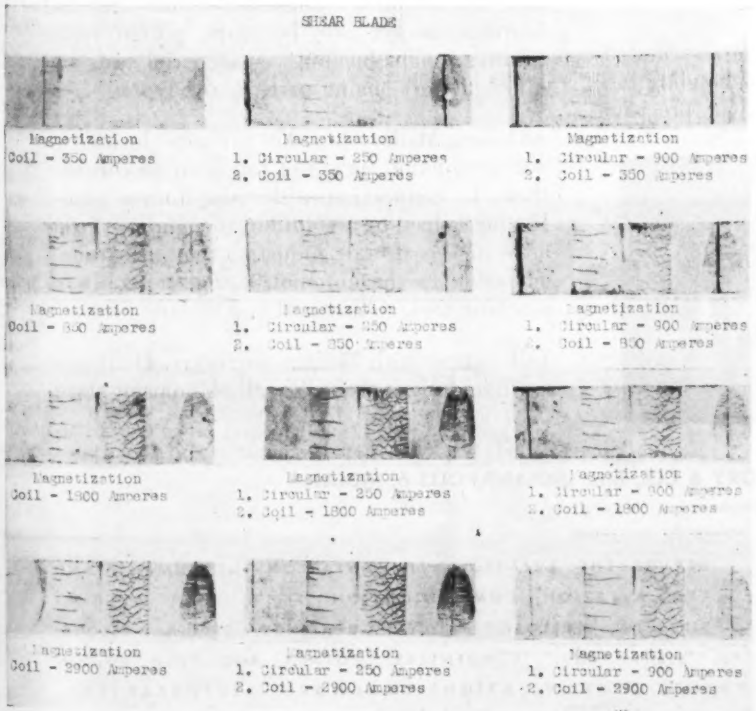


FIG. 4.

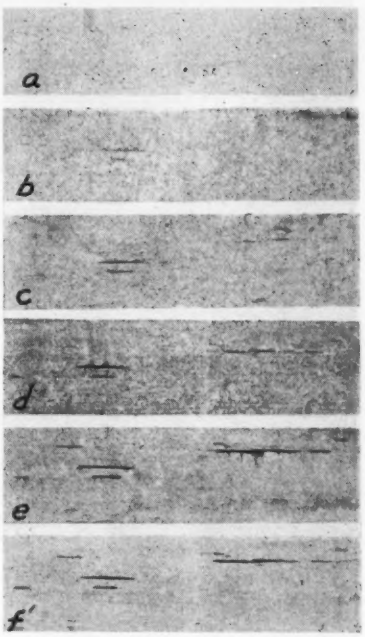


FIG. 5. Three examples of double-magnetization tests on an engine cylinder. *a*, *c*, and *e* show circular magnetization in steps of 300, 550, and 950 amp. In *b*, *d*, and *f*, coil magnetization of 3,000-amp. turns was first applied before the respective circular magnetization.

TABLE 3

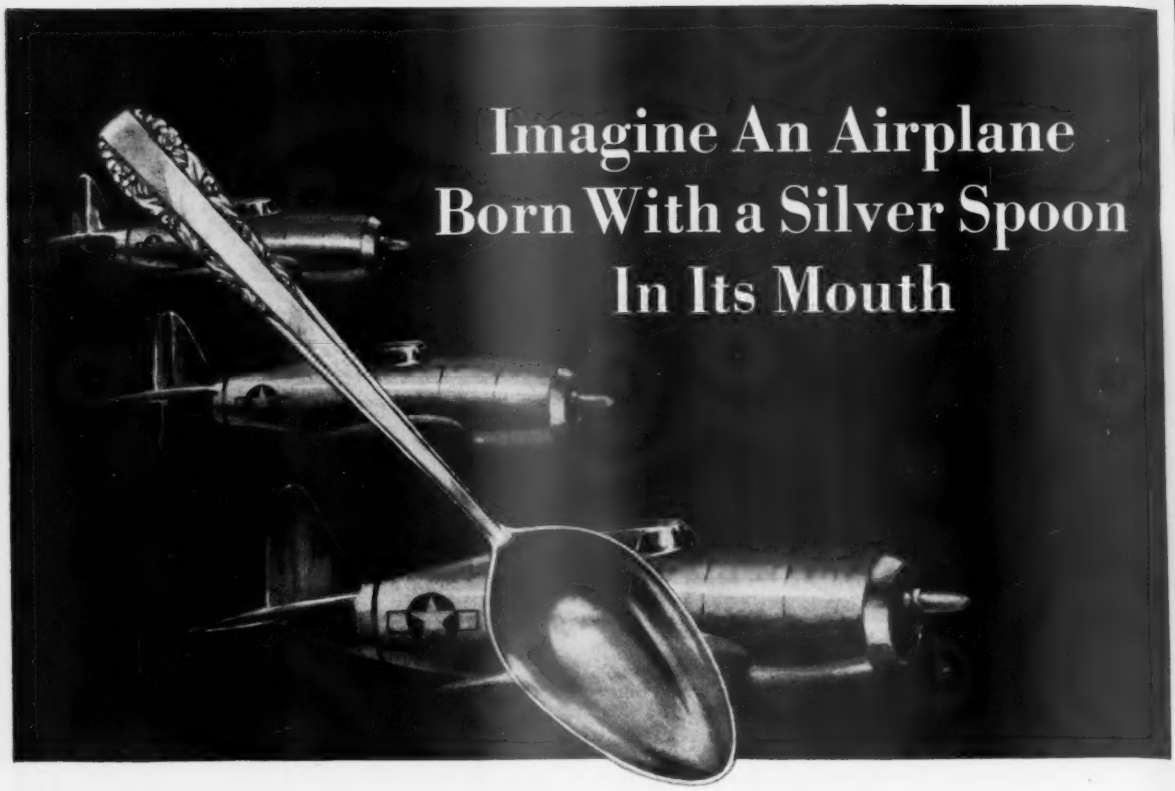
Coil Magnetization (Amp. Turns)	Flux Density of Part	Flux Density (Part Reversed)	Flux Density (Part Reversed Again)
3,000	7.5	7.0	7.0
4,800	16.0	15.0	15.0

EFFECT ON INDICATIONS

The final criterion, of course, as to whether the demagnetization step can be eliminated, is the effect on the indications themselves. To check this a series of scotch tape transfers were taken on three selected parts—a Diesel engine piston pin, the shear blade of Table 2, and a hollow cylindrical bearing.

Fig. 2 shows a series of transfers of grinding cracks, taken as the Diesel piston pin was magnetized in the coil and going from low currents to high currents. These are to be compared with Fig. 3, where the piston pin was first magnetized with 5,000 amp. circularly and then subjected to increasing values of coil magnetization. In Fig. 2 the first transfer at a coil magnetization of 230 amp. shows the longitudinal cracks only faintly. Comparing with the similar transfer of Fig. 3, it is seen that, although the coil magnetization has not eliminated the indications brought out by the 5,000-amp. circular magnetization, the transverse portion of the indications are fully as good or even better than the indications of Fig. 2 at 230

(*Continued on page 45*)



Imagine An Airplane Born With a Silver Spoon In Its Mouth

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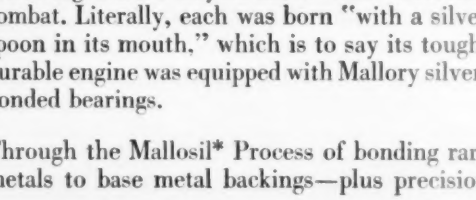

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Introduction

It is the purpose of this paper to outline the problem of automatic control of turbosuperchargers and to describe the type B electronic control system as applied to present multi-engined bombers.

The turbosupercharger is a turbine-driven centrifugal-type air compressor. It is used to boost carburetor inlet pressure to secure greater power output and better performance of aircraft engines at high altitudes.

Fig. 1 shows a schematic diagram of a typical engine with its turbosupercharger. Hot exhaust gases from the engine pass through the inlet and enter the nozzle box, which surrounds the periphery of the turbine wheel. The speed of the turbine wheel and its direct-connected compressor impeller is precisely controlled by opening or closing of the waste gate. With the gate closed, all of the gases impinge on the turbine buckets. As the gate is opened, an increased proportion of the exhaust gas is permitted to pass to atmosphere without doing work on the turbine buckets, and the speed of the turbine decreases.

Air at atmospheric pressure is brought into the supercharger air intake, and its pressure is increased by the impeller. It passes from there to the intake of the carburetor after losing some of its heat of compression to the intercooler. The internal blower further increases this pressure to the manifold, except as modified by the throttle.

The Requirements of an Effective Control System

(1) *It should be completely automatic.* One of the greatest problems confronting military pilots today is that of maintaining desired manifold pressures under widely divergent and rapidly varying conditions. When in actual combat, the pilot will be more proficient if he can devote his entire time to maneuvering his plane. It should not be necessary to continually manipulate his engine controls to maintain power output within desired limits.

Fig. 2 shows a curve of power fluctuations resulting from throttle manipulation. This was taken from motion-picture records during a formation flight at 25,000 ft. As will be noted, the type B electronic control maintained almost constant carburetor inlet pressure, permitting the pilot to make power changes with the throttles alone.

(2) *It should establish a safe maximum limit on manifold pressure.* The control system should be such as to minimize the probability of inexperienced or overtaxed pilots' setting up excessive manifold pressures with the resultant loss of an engine or engines.

(3) *A suitable control system should establish a safe maximum turbine speed.* Because of weight limitations in aircraft design, safety factors are limited. The margin between top operating speeds and the limits of safe operation must be small. A control must permit safe top operating speeds when that "last ounce" is needed, without allowing an inexperienced or overtaxed pilot to exceed the safe limit.

(4) *The system should operate successfully at low temperatures.*

(5) *It should act as a vernier control of power.* Control of power at high altitudes is most economically effected by change of boost pressures, rather than by change of throttling. If the boost control can be made simple, it becomes a valuable asset to precision power control for high-altitude bombing and close formation flying. At the same time, it

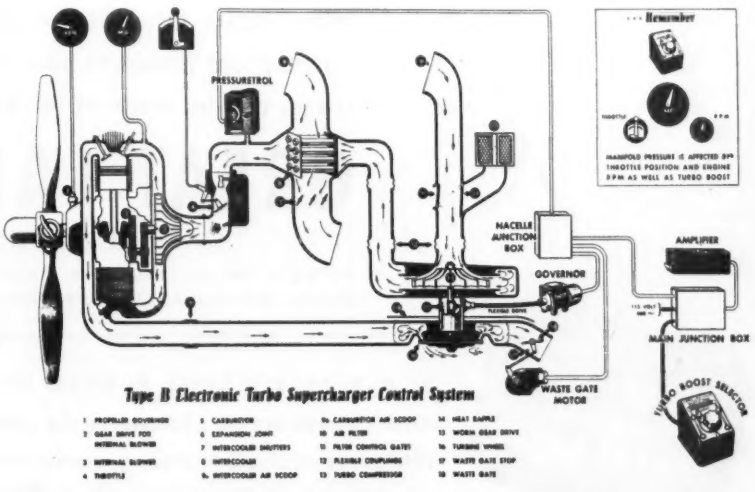
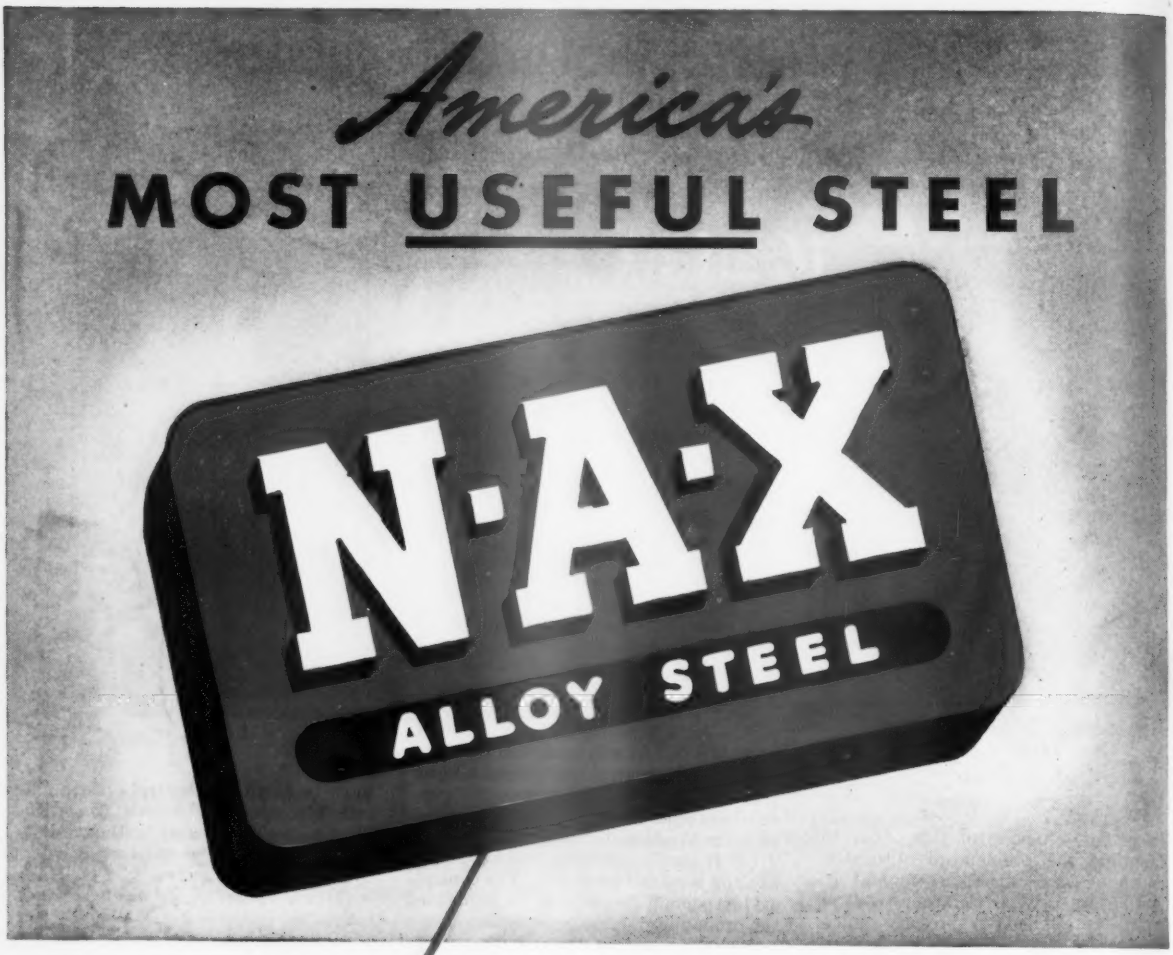


Fig. 1. Schematic diagram of induction and exhaust system of a turbosupercharged engine with electronic controls.

Presented at the Radio and Instruments Session, Twelfth Annual Meeting, I.A.S., New York, January 25–27, 1944.

* Chief Engineer, Aeronautical Division.

† Chief Electrical Engineer, Aeronautical Division.



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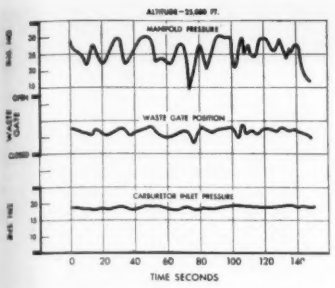


FIG. 2. Power changes during formation flight.

should in no way interfere with the control of power through throttles when it is desired to obtain more rapid power changes.

CONTROL SYSTEM POSSIBILITIES

The direct approach to the control problem is to automatically position the waste gate to some pressure point in the induction, combustion, and exhaust cycle. Referring again to Fig. 1, it may be seen that the waste gate could be made to respond to any one of several pressure points. Three such points are: exhaust back pressure, manifold pressure, and carburetor inlet pressure. Each sensing point has both advantages and disadvantages.

Exhaust Back Pressure

Until recently, this was the most commonly chosen control point. The waste gate would automatically reposition to maintain a selected pressure at this point.

Throttling at high altitude does not affect power until the closed waste-gate position is reached. If the throttle is partially retarded, the tendency is to reduce exhaust back pressure along with manifold pressure. The gate closes to re-establish exhaust back pressure, which it does by increasing carburetor inlet and manifold pressures. The result is unnecessarily high turbine speeds, inefficient operation, and poor power control.

Through exactly the same sequence of events, no obvious indication is given the pilot of the throttling effect of carburetor ice. The waste-gate control compensates for any effect due to ice until extreme conditions are reached. This, plus the tendency for condensate in the exhaust to settle and freeze in the sensing line, makes for unsatisfactory cold weather performance.

Manifold Pressure

Since a control for a turbosupercharger is usually thought of as a manifold pressure control, manifold pressure seems a logical sensing point. One advantage of controlling to that point is that it establishes a definite top limit on manifold pressure, irrespective of altitude. It also tends to eliminate tendencies for the engine r.p.m. to overshoot during rapid power changes at altitude.

However, this sensing point has the same disadvantages with respect to throttling and icing as exhaust back pressure. Since the system maintains a selected manifold pressure, throttling will have no effect except the undesirable increase of carburetor inlet pressure and turbine speed.

One device has been used to improve this condition. The "boost" selector is attached to the throttle so that retarding the throttle reduces boost. This provides power control, partially by throttling and partially by the reduction of turbine boost. However, it has the inherent disadvantage that, except at full throttle, economy is lost because of higher-than-necessary carburetor inlet pressures, and it provides no independent control of the supercharger.

Carburetor Inlet Pressure

The third possibility is to sense carburetor inlet pressure and maintain it at a selected value.

The maximum possible manifold pressure is thereby limited to that increase over carburetor inlet pressure

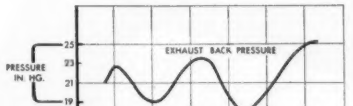


FIG. 3. Hunting in unstable control system. Altitude, 25,000 ft.

caused by the internal engine-driven compressor at maximum engine r.p.m. and open throttle.

Maximum engine economy is effected by flying with minimum boost until full throttle position is reached and then increasing the power by increasing the boost. The carburetor inlet pressure is never allowed to reach a value that results in faulty automatic mixture control.

Carburetor ice is immediately indicated by a drop in manifold pressure, since throttling has the effect of decreasing manifold pressure without a resultant increase of carburetor inlet pressure.

Throttling can be used within reasonable limits to reduce power for formation flying, and the result is decreased rather than increased turbine speeds.

Control from carburetor inlet pressure seems to provide more of the desired characteristics than the others, but it presents one important problem. This pressure point is the most difficult to sense and still maintain system stability. Because of the time lag in the response of the system, use of the conventional "floating" control is impractical.

Illustrating this, Fig. 3 shows a family of curves taken from data obtained in flight tests at Minneapolis. A system was set up to sense carburetor inlet pressure using floating control. The results clearly demonstrate the inherent time lag and the tendency toward "hunt." Starting with the top curve, a decrease in exhaust back pressure is followed by a decrease in turbine r.p.m. This reduces carburetor inlet pressure and manifold pressure. The waste gate follows the carburetor inlet pressure very closely, but there is an appreciable lag between exhaust back pressure and waste-gate position. The result is a sustained hunt.

The flow characteristics of the waste gate are such as to make control difficult. At about the half-closed position, the ratio of pressure change to waste-gate change becomes high. This is demonstrated in Fig. 4, where waste-gate position was changed manually during flight at 15,000 ft. Engine r.p.m. was 2,500, and manifold pressure, carburetor inlet pressure, and exhaust back pressure were plotted against gate position. Full throttle was maintained until manifold pressure reached military power values. At 50 per cent closed waste gate, the manifold pressure was 36-in. Hg. At 57 per cent closed waste gate, it was necessary to retard the throttle 28 per cent to keep the manifold pressure under 45 in. There was a 5-in. change between 43 and 50 per cent closed waste gate but a 9-in. change between 50 and 57 per cent with the throttle retarded.

From all of the foregoing considerations it may be concluded that a control system that senses carburetor inlet pressure will have numerous advantages over systems that sense pressure at either of the other two points. It may also be concluded that only a modulating follow-up type of control will be stable under all operating conditions.

THE TYPE B ELECTRONIC CONTROL

This electronic control was designed to fulfill the above requirements. It is fully automatic. Because it is a modulated control, it has been possible to use carburetor inlet pressure as a sensing point and thus gain the discussed advantages without introducing insta-

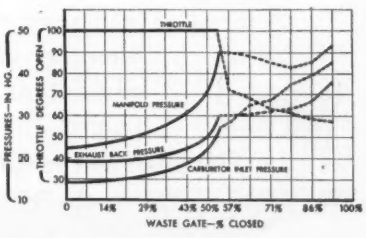
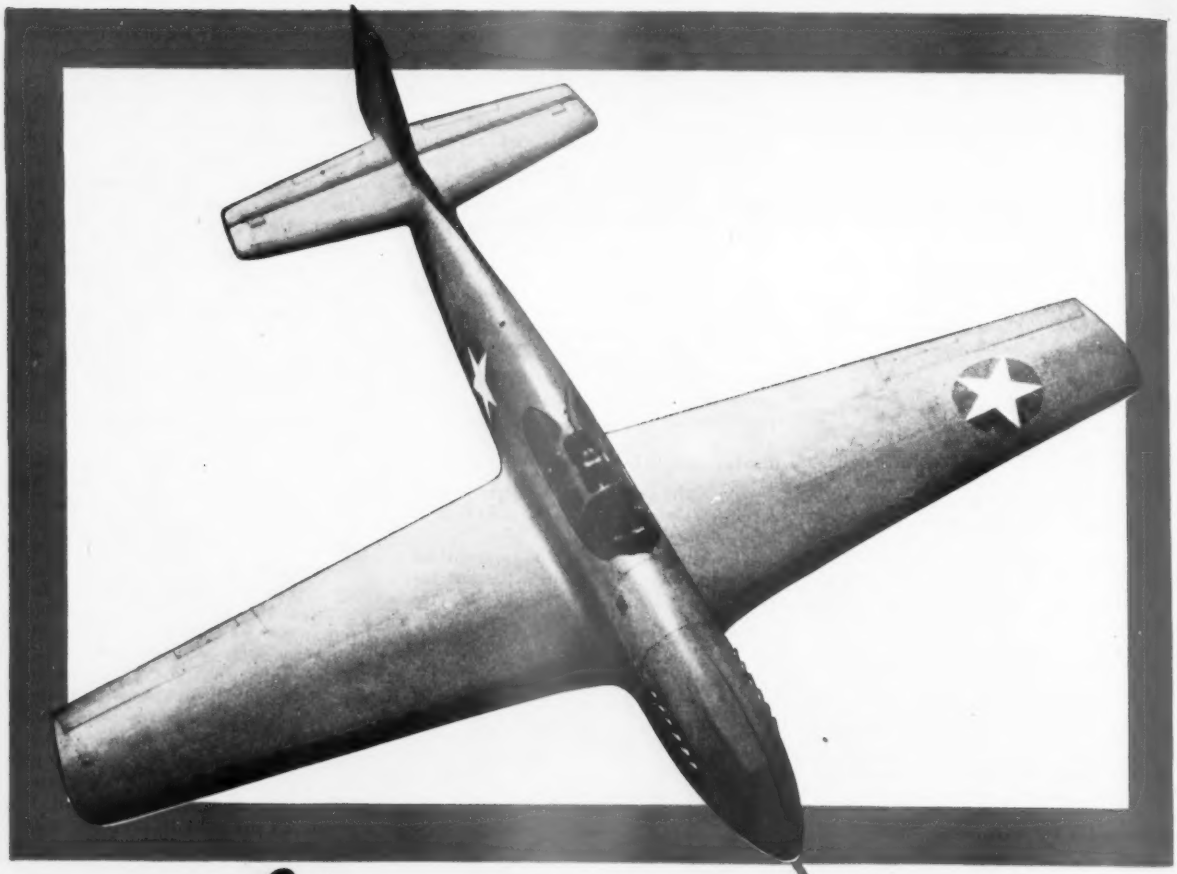


FIG. 4. Effect of manual operation of waste gate at 15,000 ft. with maximum engine r.p.m.



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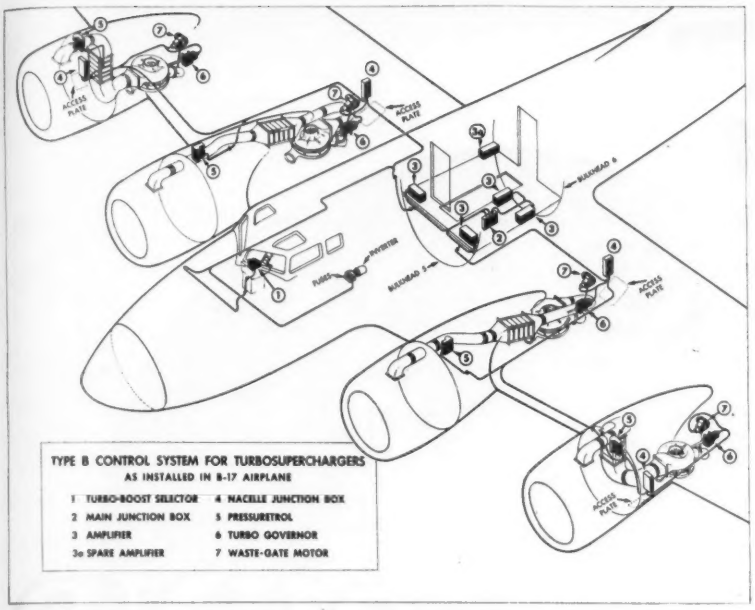


FIG. 5. Diagram of turbosupercharger control system in a B-17 airplane.

bility. It establishes a safe limit on manifold pressures. A turbogovernor establishes a safe limit on turbine speed and anticipates pressure increases from turboaccelerations to prevent overshooting of manifold pressures. Being electrical, the control system is unaffected by low temperatures. There are no make-and-break contacts to cause radio interference or service malfunctions. The single-knob control serves as a vernier control of power.

General Description

The type B control consists of a number of individual control units electrically interconnected to operate as a system. A single-engined installation consists of a waste-gate motor, an induction-system Pressuretrol, an amplifier, a turbogovernor, and a turboboost selector. In a multiengined airplane, as shown in Fig. 5, the installation includes one turboboost selector at the pilot's finger tips, plus one each of the other units for each engine.

The complete system is operated on the 115-volt 400-cycle alternating current supplied by the airplane's inverters. Power required is 67 volt-amp. per engine.

Operation of the waste-gate motor is automatically controlled by electrical signals from the turboboost selector, the Pressuretrol, and the turbogovernor. These signals, amplified and analyzed by the amplifier, control the positioning of the waste-gate motor. Each of these units will first be described, and then their interrelationship in the electrical bridge circuit discussed.

Waste-Gate Motor

The waste-gate motor, shown in Fig. 6, is a two-phase reversible electric motor which positions the waste gate through a mechanical linkage. In addition, it operates a balancing potentiometer within its own case.

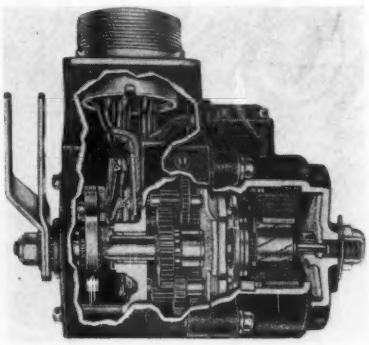


FIG. 6. Waste-gate motor—cutaway view.

Induction System Pressuretrol

The Pressuretrol is the sensing element that converts into electrical signals the pressure of the air supplied by the turbine to the carburetor. As shown in Fig. 7, two bellows are used, the operating bellows and the reference bellows. Together they move a potentiometer wiper by means of a sector arm and pinion gear.

Turboboost Selector

The turboboost selector, shown in Fig. 8, is the pilot's control device with which he selects the desired turboboost. The system then automatically maintains this amount of boost. The selector contains four small calibrating potentiometers that require adjustment only to compensate for small differences in engine and turbine performance. Once the calibrators are set, the pilot can control the turboboost on all four engines simultaneously by turning the large central control knob.

Turbogovernor

The turbogovernor, shown in Fig. 9, is a dual safety device driven by a flexible shaft from the oil pump of the turbosupercharger. One part of the mechanism, called the overspeed control, prevents the turbine from exceeding its safe operating speed. This is accomplished by means of a clutch-operated gear-driven potentiometer. The other part, the accelerometer, anticipates the pressure increase from turboacceleration and provides a potentiometer movement which introduces a signal to start opening the waste gate in time to prevent overshooting of the manifold pressure.

Turboamplifier

The amplifier, shown in Fig. 10, is an intermediate unit between the control units and the waste-gate motor. It receives two kinds of signals from the other control units. One kind calls for rotation to open the waste gate; the other, for rotation to close the waste gate. After amplifying the signal, the amplifier determines the direction of waste-gate movement called for and controls the positioning of the waste-gate motor accordingly.

Bridge Circuit

The potentiometers in the control units—turboboost selector, turbogovernor, and Pressuretrol—are interconnected with the balancing potentiom-

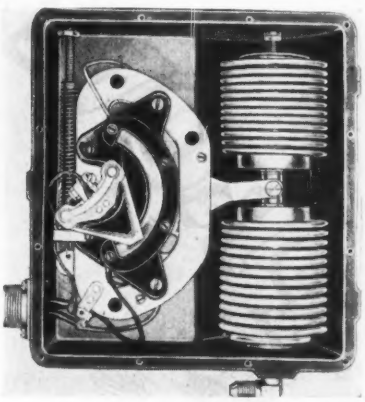
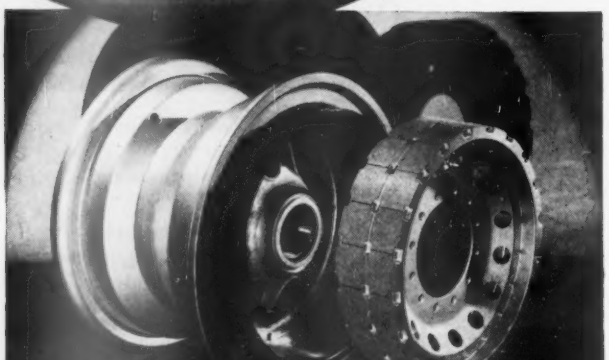


FIG. 7. Pressuretrol—cover removed.

FIG. 8. Turboboost selector.



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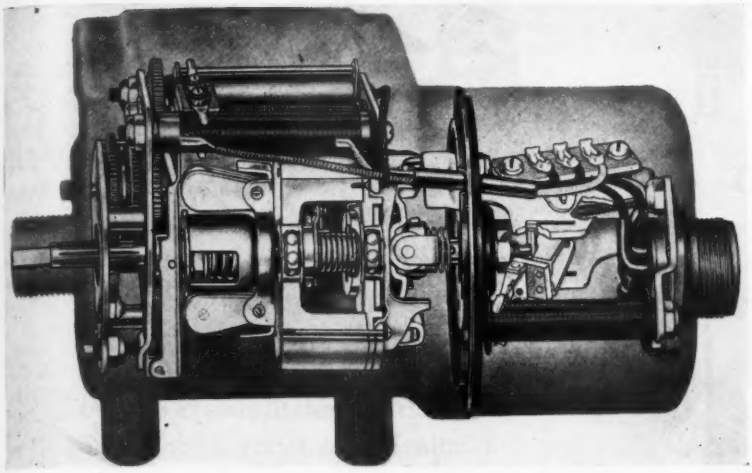

FIG. 9. Turbogovernor—phantom view.

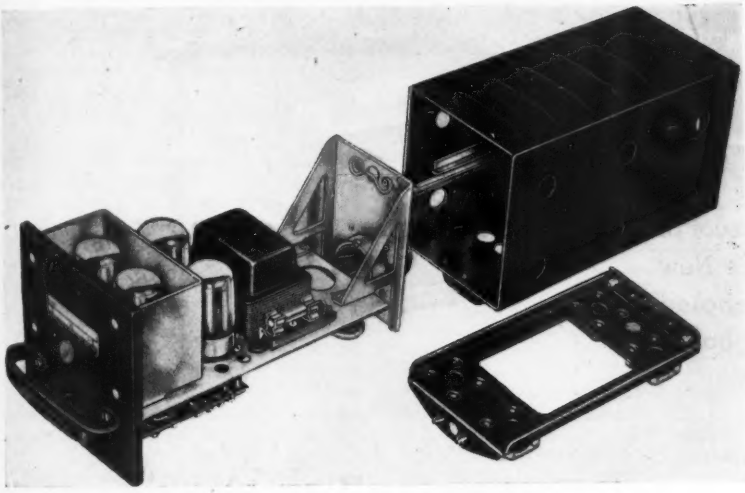

FIG. 10. Turboamplifier.

eter in the waste-gate motor to form an electrical "bridge" circuit.

Fig. 11 shows a schematic diagram of the turbocontrol bridge circuit. Examination of this diagram shows that the bridge circuit consists of three distinct sections, "X," "Y," and "Z," any of which can and does produce voltage signals. The voltage signals produced by these three sections either add to or subtract from one another. In order that a condition of balance can result, these voltage signals must cancel out so that no voltage appears between the waste-gate motor wiper arm, which is connected to the grid, and the turbo-boost selector wiper arm, which is connected to the ground.

While the control system employs an alternating current bridge, instantaneous voltages will be assumed in order to simplify discussion. The right end of the transformer windings will be considered as positive and the left ends negative.

Fig. 12 is a schematic diagram of the control system bridge, showing the conditions of instantaneous polarity assumed for discussion. The bridge diagram has been drawn to illustrate a balanced bridge condition. Starting with ground as a reference point and working up through the bridge, a 6-volt potential exists between wipers A and B, with B negative to A. Following on up into section "Y," it may be seen that D is 6 additional volts negative to C, making D 12 volts negative to A. F, it will be found, is 12 volts positive to E, so that by simple algebraic addition F and A are at the same potential.

When this condition of "balance" exists, there is no signal to the grid of the amplifier. If wiper F were 3 volts to the left of its present position, F would be 3 volts negative to A. Negative signals cause the waste-gate motor to rotate in such a direction as to close the waste gate, bringing F back to its original position and thus rebalancing the bridge. In the same manner, were wiper F 3 volts to the right of its present position, the potential of F would be 3 volts positive to A, causing the waste gate to run toward the open position, rebalancing the bridge.

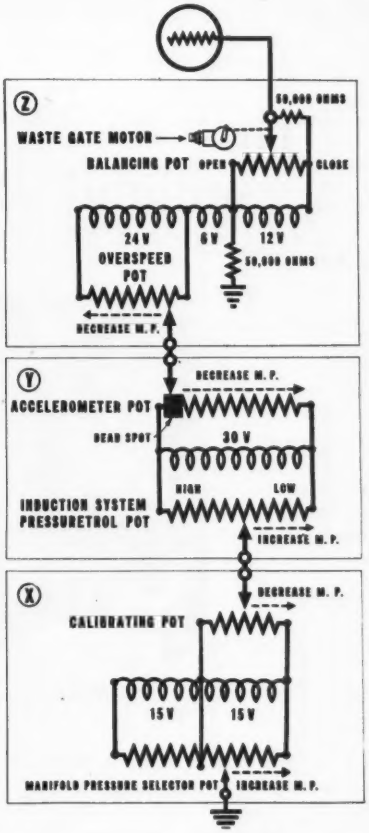

FIG. 11. Control bridge—schematic.

In actual operation, two or more wipers are caused to move simultaneously. Therefore, it will be well to follow through one simple operation to see how modulating control is obtained.

If, with the bridge balanced, the selector dial is turned to a higher boost setting, the waste gate moves toward the closed position. As this happens, the turbine accelerates and carburetor inlet pressure increases. The increase in this pressure moves the Pressuretrol

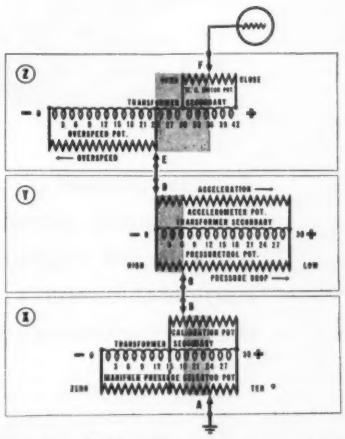

FIG. 12. Bridge diagram with voltages shown.

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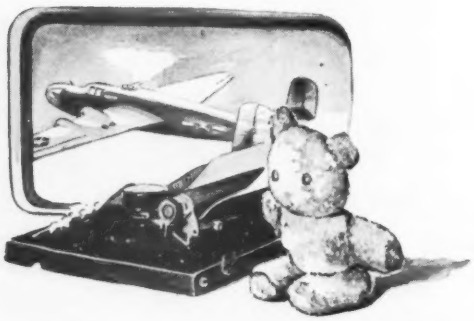

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wiper to the left, which in turn calls for the waste gate to move toward the open position. A new condition of balance results, with the waste gate slightly closed from its original position and the carburetor inlet pressure, and consequently the manifold pressure, increased from their original values.

Performance of the Control System

In considering the operation of the turbosupercharger, and the performance of the type B control system, refer to Fig. 13. This set of curves outlines typical operating conditions for the turbosupercharger system during a climb from an altitude of 5,000 to 32,000 ft. On Fig. 13 C.I.P. is labeled induction-system pressure, as these terms are often used interchangeably.

First, the engine r.p.m. is selected (2,300 for this illustration) by setting the propeller governor control. The r.p.m. remains constant throughout the climb because of the action of the automatic propeller governors.

The throttle is then moved forward to full-open position, and a manifold pressure of 37 in. is selected by means of the turboboost selector.

The pressure "boost" supplied by the internal engine blower, as represented by the difference between the carburetor-inlet pressure and manifold pressure, is a fixed value as long as engine r.p.m. remains constant. Therefore, to maintain a constant manifold pressure, it is necessary to maintain a constant induction-system pressure.

Atmospheric pressure decreases with an increase in altitude, as represented by the atmospheric pressure curve on the chart. To maintain a constant carburetor-inlet pressure and, consequently, a constant manifold pressure during a climb, it is necessary that the turbine increase in speed. This increase in speed is represented by the turbo r.p.m. line on this chart. It will be noted that the maximum turbine r.p.m. was reached at approximately 30,000 ft. Here the overspeed portion of the turbogovernor became effective to prevent further increase in speed.

Turbine r.p.m. is a function of the pressure differential across the turbine wheel and is controlled by positioning the waste gate. As altitude increased, the waste gate moved toward a closed position to increase turbine r.p.m. At

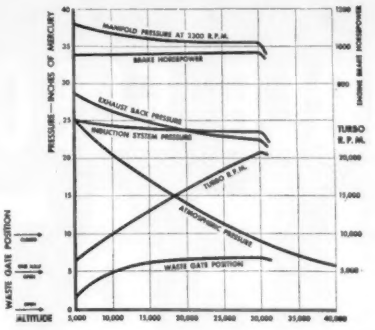

FIG. 13. Turbocontrol operation curves.

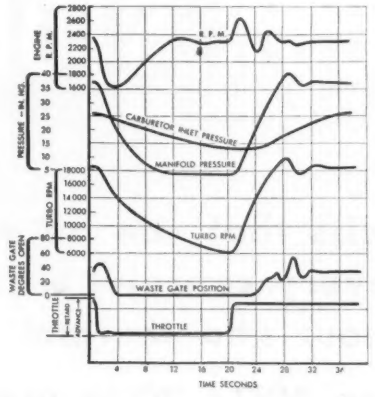

FIG. 14. Effect of ramming throttles at 25,000 ft.

first a fairly large amount of waste-gate movement was necessary, but, as the waste gate approached and passed the half-closed position, little movement was required. This condition is a result of the flow characteristics of the waste gate referred to earlier in this paper.

The resultant effect on manifold pressure is that a slight "droop" is evidenced at the beginning of the climb but that less "droop" occurs during the remainder of the climb until, of course, an altitude is reached at which the overspeed control takes effect. The amount of manifold-pressure droop has been carefully chosen to give nearly constant horsepower throughout the climb.

As altitude is increased above 30,000 ft. and the turbine reaches rated speed, the turbine discharge pressure and, hence, the manifold pressure drop off quite rapidly. Safe turbine speed is the final determining factor limiting the altitude at which full rated horsepower may be obtained.

The curves used are for illustrative purposes only, and similar ones can be drawn for higher or lower manifold pressures.

CONCLUSION

In conclusion, the curves shown in Fig. 14 are offered as an example of the operation of the type B regulator under extreme conditions. These curves are prepared from motion-picture records of a flight test.

The test was made at an altitude of 25,000 ft. The procedure was to retard one throttle fully and wait until the system restabilized. The throttle was then rammed to full-open position in less than 1 sec. This is a severe test for any regulator.

Referring again to Fig. 14, it may be seen that as the throttle was retarded the manifold pressure dropped quickly. The propeller governor re-established propeller speed after a period of several seconds. The waste gate then went fully closed and the turbine speed dropped.

Then the throttle was rammed full-open and things began to happen. Manifold pressure increased. Turbine r.p.m. increased. It was the regulator's job to see that original conditions were re-established as soon as possible without exceeding safe turbine speed or manifold pressure and without setting up a "hunt" or other unstable condition. Just how well this was actually done is demonstrated by the curves. You may even observe a fluctuation as the turboregulator attempted to compensate for a sluggish propeller governor. You may also see how the accelerometer portion of the governor caused the waste gate to open sooner than it would have otherwise and thus limited to a modest amount the overshoot of manifold pressure.

The type B electronic control system for turbosuperchargers is today flying in our large bombers, serving to make the pilot's task simpler and high-altitude flying more dependable.

(*Continued from page 35*)

amp. As the coil current is increased in Fig. 3, the longitudinal indications fade out, but the transverse indications still correspond to the equivalent transfers in Fig. 2.

The transfers for the shear blade are shown in Fig. 4. On this particular part the transfers were taken by applying the scotch tape across the wedge. This shows (left to right) a longitudinal crack, some transverse indications of grinding cracks, a complex pattern of grinding cracks, and another longitudinal crack. The last face had been ground to find the depth of the crack. By comparing similar conditions of transverse indications with and without previous circular magnetization, it is seen that the transverse indications have not been weakened. Longitudinal cracks were so heavy that it was difficult to obtain good transfers without smearing.

As an example of going from longitudinal magnetization to circular magnetization, the transfers of Fig. 5 were taken. On this part there was a gain in sensitivity by using the double magnetization. The indication for 300-amp. circular alone is practically invisible, while it shows clearly for the case where the part was premagnetized in the coil at 3,000 amp.

Other parts tested gave essentially the same results as those on which transfers are shown.

CONCLUSIONS

In no case was it found that demagnetization between circular and longitudinal magnetizations, or vice versa, was less effective than a single magnetization starting from an unmagnetized condition of the part under test. In view of these results it is evident that the step of demagnetization between the two magnetization steps in the Magnaflux process of testing may be safely omitted, with a consequent saving of time.

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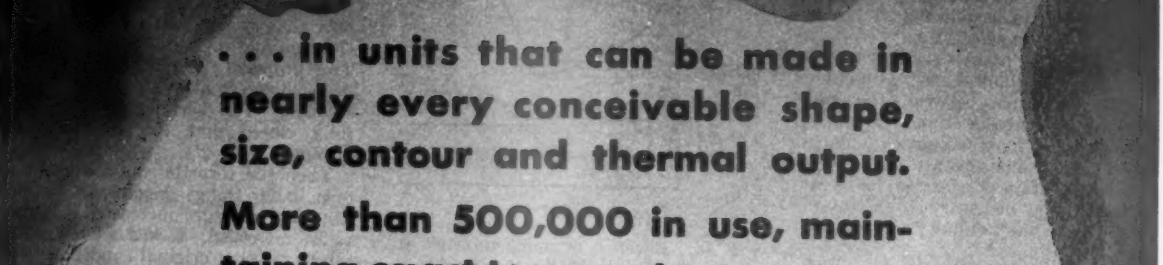

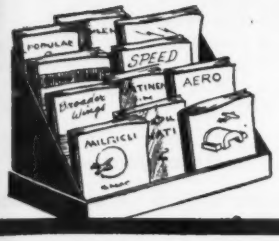

Periodicals

Accessories and Equipment

Rubber Mountings Simplify Aircraft Vibration Control. The construction, advantages, and aircraft applications of Silentblock rubber mountings are noted. Necessitating no cement, these mountings employ pressure and the resulting friction to prevent slippage between rubber and metal. They are reportedly used for instrument panel, radio, and engine mountings, and are being considered for other applications where vibration must be isolated or shock absorbed.

In its simplest form the Silentblock mounting is described as a cylindrical rubber "biscuit" contained between an inner and outer sleeve of metal. The biscuit is contracted into the outer sleeve, which is of small diameter, thus causing the rubber to apply continuous pressure against the outer sleeve. By varying the size of the biscuit in relation to its metal sleeve, the load-carrying ability of the mounting can be increased or decreased according to need. *Aero Digest*, August 1, 1944, page 83, 4 illus.

Fire Risk in Aircraft. S. W. G. Foster. Means are suggested for reducing the risk of fire in airplanes. The following methods and equipment for preventing and stopping aircraft fires are discussed: (1) crashproof tanks for gasoline and oil; (2) self-sealing couplings in pipe lines; (3) isolation of parts liable to cause fires; (4) provision of a really efficient automatic fire-extinguishing system; (5) electrical apparatus that is protected from short circuits and subsequent sparks; (6) isolation of source of electrical supply; (7) shielded or cooled parts that are liable to ignite gasoline or oil vapor; (8) extensive use of fireproof paint; (9) prevention of static discharges, etc.; (10) prevention of sparking from ground when crash landing; (11) fireproofed clothing and upholstery; (12) provision of an efficient form of cabin ventilation so that any flames liable to be sucked into the system can be isolated quickly. *Flight*, July 20, 1944, pages 67–69, 7 illus.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

Lighting Required for Commercial-Airline Aircraft. W. A. Petrasek. This article outlines the essential role that lighting plays in the performance of aircraft and acquaints the reader with the basic requirements of each of the specific applications. Actual air-line operating experience forms the basis for these requirements. In a section on exterior lighting, the writer discusses position lights, landing lights, and auxiliary lights. Cabin lighting and cockpit lighting are discussed in a section on interior lighting. The writer's conclusions are that there is need for the development of: colored position-light sources of greater intensity and better efficiency; a light that will meet all landing and ground-running requirements without increasing the weight of the installation; lights of longer life; and better interior lighting. *Electrical Engineering*, August, 1944, pages 593–598 (Transactions), 14 illus.

Flying Fortress Equipped with Glycol Heating System. Details of the glycol heating system used on the B-17F are described and illustrated. Information is given about the main and auxiliary units, both of which operate on the same principle of heat exchange. *Automotive and Aviation Industries*, August 15, 1944, pages 30, 31, 5 illus.

Operating Principles of Oil Cooling Systems. S. K. Andersen. Aircraft-engine oil-cooling problems are discussed and information is furnished about modern oil-cooling systems designed to meet these problems. To provide extra cooling surface a separate oil-cooling unit is necessary. The writer divides oil-cooling systems into two main groups but he points out that these groups often overlap to a certain extent. The first group includes systems in which the oil temperature is regulated by a thermostatically operated valve that controls the flow of oil through a by-pass around the cooler. The second group includes systems in which the oil temperature is regulated by a thermostatically controlled mechanism

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that operates air shutters or an exit flap in the cooling-air ducts. The various components of both systems are described. *Industrial Aviation*, August, 1944, pages 26–28, 65, 66, 68, 8 illus.

Aerodynamics

Camber Line of Constant Density. Max M. Munk. The inverse of the problem of computing the lift for a given wing-section camber line is stated to be the establishment of the camber line from a given or desired chordwise lift distribution. It is considered a much less formidable problem from the mathematical standpoint. Biot-Savart's rule for computing a flow pattern from its vorticity distribution is explained. A formula is developed for determining a camber line giving rise to a constant lift density along the chord. After explaining an apparent contradiction in the mathematical rules involved, the writer states that a camber line can be obtained for an almost constant lift density, that is, constant at all points except for a slight rounding off at the two ends. The integrals are worked out, and the solution is plotted in a diagram showing that the camber line is symmetrical fore and aft and that at the two edges the slope and the given ordinates become infinite because of the specified pressure drop. A table lists the ordinates, measured from the 50 per cent station, for a given lift coefficient. *Aero Digest*, August 15, 1944, pages 111, 232, 1 illus.

Die Ausrollstrecke eines Flugzeuges mit und ohne Bremsen bei Gegenwind (The Landing Run of an Airplane With and Without Brakes, into Head Wind). H. Winter and W. Meyre. According to the authors, the fundamental German researches on take-off and landing runs have been made under the assumption that the air is calm. Consequently, they thought it desirable to supplement these investigations by their own research in which the effect of wind is taken into consideration. The authors state that it is not generally known that under definite simplified assumptions there is a possibility of finding a proper formula for calculating the landing run against a head wind. However, it is recognized that the designer must have the means to estimate quickly the prospective take-off or landing run, especially since the increased flying speeds of modern airplanes require longer runways. Such a method of calculation is developed and explained with the aid of equations and tables. It is found that in most cases the take-off run is shorter than the landing run and, therefore, the latter determines the minimum size of the airport. *Luftfahrtforschung*, February 28, 1944, pages 11–16, 8 illus.

Estimation of Aircraft Ceilings. J. F. Foss. A fresh approach is made to the problem of obtaining a general

THE GUN THAT GAVE SPRING ENGINEERS THEIR BIGGEST HEADACHE

This spring ejects the shell after firing and returns the breech mechanism to firing position. Coiled clock-spring fashion out of flat cold rolled strip, it is also coned to provide spring action axially.

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Conventional manufacturing methods were not equal to the task of holding the springs to these specifications. Processing involved the operation of forging, machining, coiling and heat treating. By unusual engineering ingenuity these operations were so closely coordinated and controlled that springs were produced that successfully met rigid government specifications, that in peacetime were almost unknown and believed impossible.

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C26—Unshielded

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curve giving the ceiling of an airplane with all engines operating and with one or more out of operation, in terms of the variables in which the performance estimator is accustomed to think. The writer presents an expression that is stated to have been found fundamentally correct and that is easy to manipulate. The expression is useful for estimating approximate ceilings, for checking more detailed calculations based on rates of climb, and for finding the effects of changes in the variables. The mathematical derivation of the expression is given. *Aircraft Engineering*, July, 1944, pages 186, 187, 1 illus.

Air Cargo

Panagra Cuts Larger C-53 Hatch for Oversize Cargo. Bradley H. Young. How a change to larger cargo doors than the standard was made in a C-53 transport plane without weakening the structure of the fuselage is described. *Air Transport*, August, 1944, pages 45, 46, 49, 5 illus.

AAF 'Chute Delivery System May Be Used Commercially After War. Alexander McSurely. A brief description is given of the aerial delivery system perfected by the Army. It is stated that the method may be employed in peacetime to carry merchandise to communities lacking landing facilities. *Aviation News*, August 28, 1944, page 15.

Air Cargo Loading. M. D. Miller. Suggestions are offered on methods of loading cargo in aircraft. The proper allocation of cargo weight, the division of cargo space, securing of articles, provision of adequate protection for small and fragile pieces, and packing and loading equipment are discussed briefly. Five basic rules for handling air cargo are summarized: (1) Do not exceed the allowable gross weight of the airplane. (2) Do not exceed the allowable floor loading. (3) Load to maintain proper airplane balance throughout the flight. (4) Handle and stow cargo so as to obviate damage and danger to airplane, crew, and cargo. (5) Load so as to permit expeditious handling at next station. *Air Pilot and Technician*, August, 1944, pages 15–17, 5 illus.

Air Law

Nationality of Aircraft—a Misnomer. Margaret Lambie. The writer challenges the concept of nationality of airplanes in legal negotiation and explains why nationality is not an indispensable attribute of aircraft. Comparing the legal status of airplanes with that of ships and automobiles, she claims that all the desired ends may be achieved through the process of registering aircraft with appropriate safeguards of airworthiness and through proper administration nationally and internationally. In support of this thesis an amendment is proposed to the Civil Aeronautics Act. This amendment would delete from the Act the term "nationality" and the phrase "of the United States" after "civil aircraft," defining ownership of aircraft as personal property and adding to the method of registration by the owner an alternative of registration by a duly accredited agent of the owner. Such an amendment would substitute in the quoted passage "ownership" for the word "nationality." *U. S. Air Services*, August, 1944, pages 24, 26.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Legal Liability for Property Damage by Aircraft. Glenn N. Lempereur. A consideration of the problem of liability for damage to the property of others as a result of aircraft operation. It is explained that various legislations and interpretations with regard to the *ad coelum* doctrine (the extent to which a man owns the air space above his property) sometimes make a pilot liable for damages arising from innocent passage through the air without forced landings or crashes. Cases of such damages are cited, and the almost unlimited extent to which liability may extend from a crash is also pointed out. The need for abolishing the rule of absolute liability is stressed, while the pilot is urged to avoid potential liability by avoiding low-altitude and reckless flying. *Aero Digest*, August 15, 1944, pages 58, 59, 138, 140, 2 illus.

Mr. Drumm and the C.A.A. Paul McNamara. The thesis of this article is that, under the present Constitution of the United States, the legal status of certain C.A.A. regulations is questionable. While conceding that the so-called "commerce clause" on which the Civil Aeronautics Act of 1938 is based provides ample justification for Federal control of air-line flying and all interstate business flying ventures, the writer points out that it does not cover local flights or pleasure flying in general. To avoid conflicting Federal and State laws, duplicating license laws, regulations adverse to one another, and a general legal confusion detrimental to aviation, he suggests an amendment to the Constitution, which will clearly define governmental authority over the air space above the United States. *Air Facts*, September, 1944, pages 19, 20, 22, 24, 26.

Air Power

Air Power Can Be Peace Power. G. W. Vaughan. The President of Curtiss-Wright Corporation discusses methods by which the United States can insure the peacetime existence of its aviation industry. Describing the postwar problems with which the industry is faced, he recommends adherence to the air-power policy and conversion program developed by the Aeronautical Chamber of Commerce. As outlined, this policy provides that the United States maintain air power sufficient, in conjunction with other forces, not only to win the war but also to keep the peace by: (1) maintaining adequate air forces at such strength and in such state of readiness as to preclude a successful assault upon the United States or its possessions; (2) acquiring and maintaining air bases essential to national security and overseas trade; (3) facilitating the orderly and economic expansion of domestic and international air transport and private flying; (4) preserving a strong aircraft manufacturing industry. *U. S. Air Services*, August, 1944, pages 11–13, 2 illus.

French Air Force—1944. General de Division Aerienne Martial Valin. Its Deputy Commander-in-Chief reviews the activities of the French Air Force since the fall of France in 1940. He relates how, after the French-German armistice, French air-force units were formed to operate outside of France. He also tells of their combat record during the years from 1940 to 1944 in the Mediterranean area, in Britain, and finally in Normandy.

At present, French Air Force groups are reported to be operating from Russia and Italy, as well as from Normandy and Britain. *The Aeroplane*, July 28, 1944, pages 96, 97, 5 illus.

How We Must Use Air Power. Brig. Gen. Henry J. Reilly, O.R.C. An analysis of how Allied air power has been employed during recent invasion battles in both the Pacific and European theaters of war. The writer claims that operations in the Pacific are being conducted on Napoleonic principles and those in Europe according to Douhet's theories, with the result that in the former case all types of fire power are concentrated on the enemy's armed forces during battle, while in the latter case ground troops and sea forces are subordinated to aviation. It is his contention that the development of forces in the European theater is incorrect and that a quicker and more decisive victory could be won if air power were concentrated mainly for the direct support of land troops. His thesis is supported by the argument that, while bombing of supply sources and bases has not ended the use of weapons like robot bombs and submarines, capture of such bases by ground forces would have the desired effect. *Flying*,

September, 1944, pages 21–23, 142, 152, 154, 158, 2 illus.

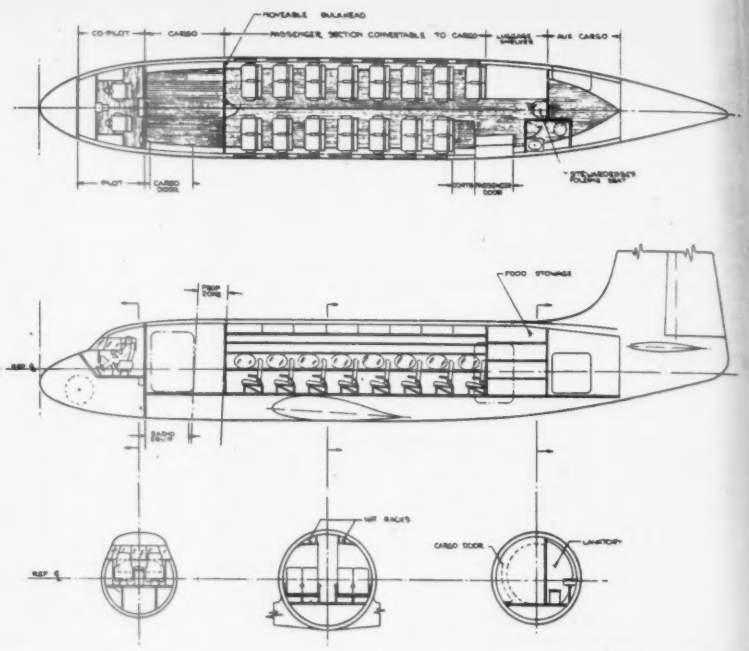
Target Japan. Leonard Engel. The prosecution of the war against Japan is discussed with particular reference to air power. Information is furnished about the number of aircraft carriers that the Allies can use against Japan after Germany is defeated. The writer discusses the significance of Admiral Nimitz' westward and northward drive and enumerates the prerequisites for a direct invasion of Japan. Reference is made to the ebb in the Japanese strength, which is stated to be most apparent in the air. The rapidly increasing production of Allied aircraft is contrasted with Japan's decreasing production. Future bases for air action against Japan are considered. A chart shows the distances between possible future bomber bases and Tokio. *Air Trails*, October, 1944, pages 24, 25, 60, 64, 2 illus.; "New Order of Naval Power," by Leonard Engel, *Air News*, September, 1944, pages 20, 21, 7 illus.

What Can Airpower Do? William Kimball. The potentialities and limitations of air power are discussed. Old and new conceptions of what can be accomplished with air power are outlined. It is stated that war experience has provided a new and much more complicated picture of what this weapon can do. Negative aspects of the subject are first discussed. It is stated that there is no such thing as bombing a nation or even a city out of existence. Air power is an intermittent offensive power. It cannot be applied continuously. This means the enemy has time to repair his installations. Air power is subject to weather conditions, and must depend on surface transportation and air bases. Positive aspects of air power are enumerated. The writer discusses its use as a strategic instrument of destruction, as a tactical arm against land or sea weapons, as a third dimensional branch of infantry attack, and as a means of supply. *Mechanix Illustrated*, September, 1944, pages 52–54, 152, 153, 3 illus.

Air-Warfare Review. Gill Robb Wilson. A series of comments on the role played by air power in the Normandy invasion. While the writer credits the success of the invasion to the coordination of air, sea, and ground forces, he stresses the value of air power's versatility and mobility to the entire operation. He demonstrates that the airplane lends itself to a freedom of action impossible to any other component of military or naval action. *Skyways*, September, 1944, pages 8, 99, 1 illus.

Air Transport

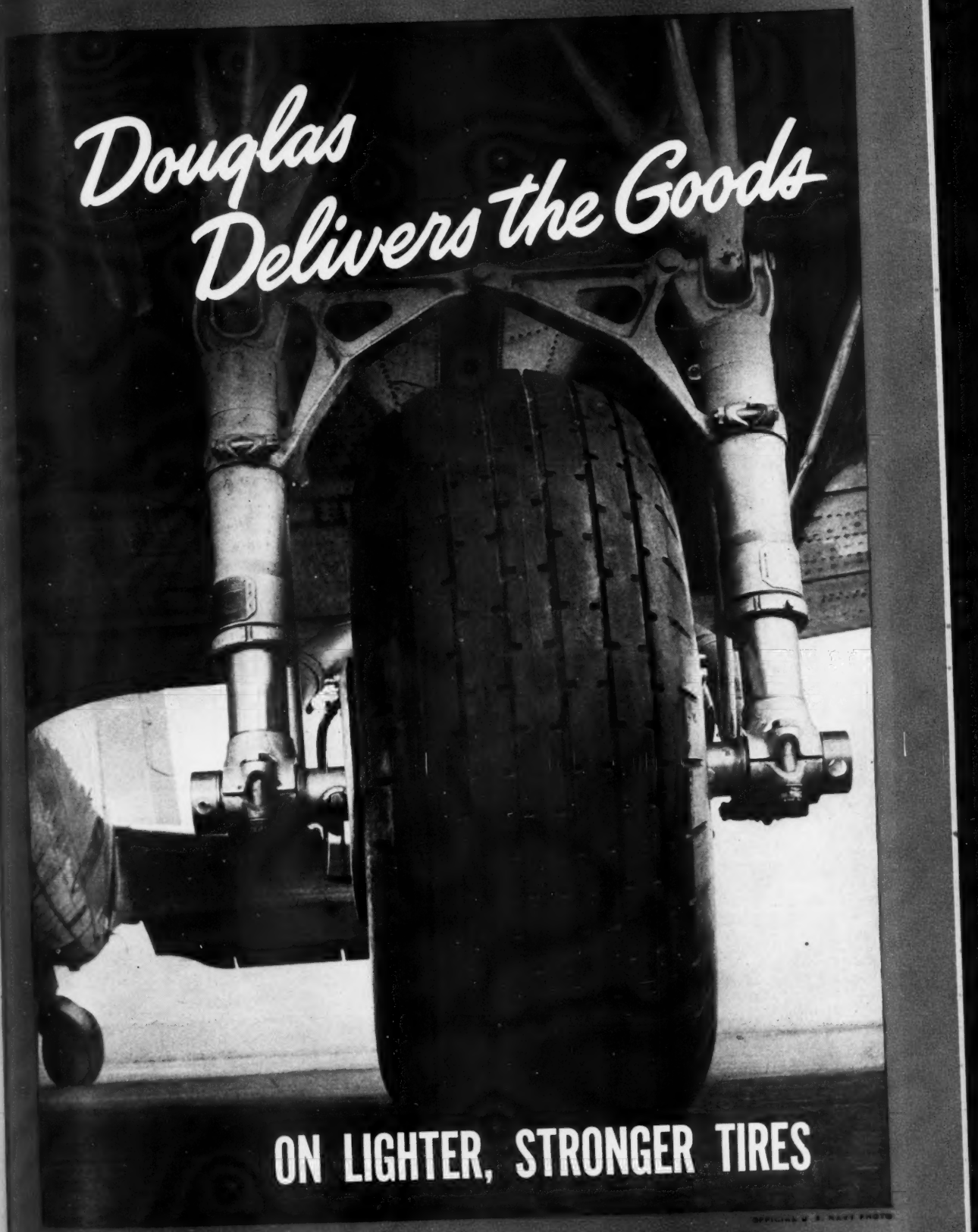
Reconversion of Army Planes. Part I. J. A. Butcher and R. E. Franz. The first of two articles investigating the engineering problems of air lines converting aircraft from specifications for military service to those which will fit them for civil air transport. Discussion in these articles is restricted to the particular phases of conversion projects which may be termed engineering functions, directly chargeable to engineering. Part I begins with a consideration of the various problems of conversion costs and who is to pay for them. It then goes on to outline the procedure that must be followed by an air-line engineering department in directing and carrying out a conversion project. It relates how the engineering department must anticipate and be prepared to do the following: (1) Supply all basic structural information regarding the particular airplane and its components. (2) Supply a list of all projects and repairs, including instructions for accomplishment necessary to bring each conversion to the air-line standards maintained at the time the planes were called into military service. This is necessary since some military contracts provide that all conversion costs necessary to bring the plane to the standards of a prearranged date will be borne by the military authorities. (3) Supply a list of all projects, including instructions for accomplishment necessary to cover the interim of fleet-project work from the date of return to the present standards. (4) Supply a list of all modernization projects including instructions for accomplishment. (Weight-saving projects will be in the majority because of the necessity for flying at maximum gross loads during wartime.) (5) License the aircraft with the C.A.A., which includes preparing and submitting to the C.A.A. reports, analyses, weight and balance information, and technical details on each project accomplished on the airplane. *Aero Digest*, August 15, 1944, pages 82, 83, 126, 131, 4 illus.



The low-wing version of The Glenn L. Martin Company's Model 202 is designed to meet the A-1 specification of the Air Transport Association for short-haul postwar passenger and cargo aircraft. It is designed to carry 30 passengers and to cruise at 250 m.p.h. at 10,000 ft. with 60 per cent power. The wing loading is 44 lbs. per sq.ft.

A "Chosen Instrument" Airline? W. A. Patterson and Ralph S. Damon. The affirmative of this debate is taken by the President of United Air Lines, the negative by the Vice-President of American Airlines. Each offers his arguments to show why the method he advocates would be the most feasible way of facilitating the progress of American air transport, and preserving air-line operations under private enterprise. *Flying*, September, 1944, pages 26, 27, 144, 148, 4 illus.

British Architect Sees Air Freight Changing All Transportation. J. Percival Chaplin. Some basic points of air cargo transport are discussed. Consideration is given to speed, the size of the cargo compartment, handling efficiency, and the form and shape of the plane. It is stated that to maintain the best possible speed in the air from point to point, a balanced ground organization is essential. Reference is made to buildings that are difficult to alter and too expensive to replace at frequent intervals. Because they can be easily altered, light metal units with a large use of plastics are recommended. The possibility of eliminating buildings altogether and handling passengers and freight by mobile units is discussed. *Air Transportation*, July, 1944, pages 20, 21.



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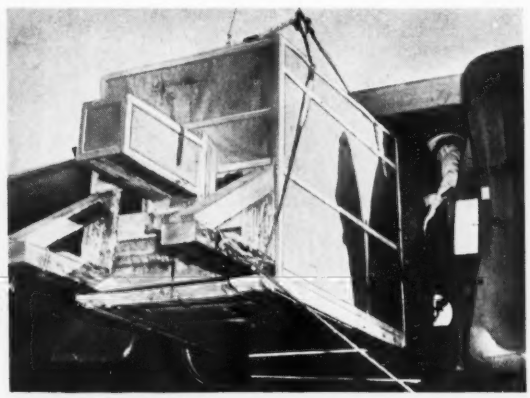

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The Douglas "Dauntless" dive bomber delivers a different kind of cargo...a 1000-pound bomb. Though production of the SBD has ceased, thousands of Douglas "Dauntless" dive bombers are still in action and will go on to establish one of the most magnificent combat records ever set by one type of warplane. In the Battle of Midway, SBD's sank four Jap carriers and from Pearl Harbor over the whole Pacific area, they carried destruction to the enemy.

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Here's a bolt from a Jap Zero shot down over New Guinea

and here's one of OURS

Johnny Pafford worked in the Inspection Department at *National* before he went to work for Uncle Sam in an anti-aircraft unit. Curious to see how the Japs' aircraft bolts compared with ours, he removed one from a Zero shot down over the New Guinea beachhead where he landed, and sent it back to us.

Examination shows that the cut thread has a close pitch tolerance, and the nut fits well. The quality in general, however, is poor compared with AN and NAS standards. The Jap bolt is not pointed and lacks a washer face under the head. It was evidently used with a lock washer, which is not regarded as good practice in our planes.

Checking on the comparator shows that the hex is out of line. The cotter hole is drilled at a point which is inaccessible when the nut is in a normal position. The nut is crudely made with no chamfer or washer face, simply a hex slug drilled and tapped.

We regard this comparison as significant simply because it portrays graphically one detail out of hundreds in which the basic *quality* of American planes excels that of the enemy.

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A New Procedure for New Route Cases. Albert R. Beisel, Jr. In this article the writer, who is a member of the Civil Aeronautics Board's General Counsel's Staff, stresses the importance of planning for new air-line route authorizations. A procedure is suggested for dealing with the complex issues inherent in the numerous new route applications pending before the Civil Aeronautics Board. *American Aviation*, August 1, 1944, pages 45, 46.

Atlantic Crossroad. E. Jay Doherty. This is an article on the airdrome at Prestwick, Scotland. It tells how Prestwick became a major terminal of the Allied air transport system and indicates the importance of the operations conducted there. Some descriptive data are given on the physical aspect of the airport; attention is drawn to the prevalence of favorable flying weather in this Scottish town; its strategic location is noted; and the question of whether Prestwick will remain an important air-line terminus in the postwar future is discussed. *Flying*, September, 1944, pages 56, 57, 136, 140, 2 illus.

By Plane or By Train? Richard H. Rush. A study of travel by air and by rail in which factors of relative cost and time for various distances are considered, and the amount of traffic handled by both transportation mediums is discussed. Tables give comparisons of air-rail distances and speeds, plane-train travel costs, and the net income and interest on funded debt of Class I steam railways from 1929 to 1941. Charts give a comparison of plane and Pullman charges between New York and Los Angeles, the distribution of passenger miles by intercity common carriers from 1930 to 1939, and railroad freight and passenger yearly net revenue from 1930 to 1942. *Air Transport*, August, 1944, pages 20–25, 6 illus.

Airplane Descriptions

Das Fliegende Motorrad A.M.-6. (The Flying Motorcycle A.M.-6). Th. Heimgartner. A description is given of a new light airplane, designed in Italy and reported in a Swedish magazine. It is stated that the designer, Adriano Mantelli, director of the Guidonia Aeronautical Research Laboratory, made successful test flights with his aircraft, called the "Flying Motorcycle A.M.-6."

This small, strong, light airplane requires little raw material, and may be flown safely and inexpensively. For his prototype the designer used a 17-hp., two-cylinder, two-cycle engine which is built into the small monocoque plywood fuselage. This engine reaches its maximum output at 4,000 r.p.m. Above the pilot's seat is a plastic hood. The wheels are installed in the fuselage and are equipped with brakes. To maintain balance when starting, one wing has to be held by an assistant until the aileron effect takes place.

Two box spars, which carry the tail unit, transmit the tail force directly forward to the wing spars. The pusher propeller operating between these two tail-support spars has a free blade swept area. The propeller axis is about level with the pilot's head.

Construction and performance data are as follows: span, 6.28 m.; length, 4.10 m.; wing surface, 6.00 sq.m.; flying weight, 200 kg.; wing loading, 33.3 kg. per sq.m.; maximum speed, 150 km. per hour; cruising speed, 130 km. per hour; landing speed, 50 km. per hour (with flaps); take-off run, 70 m.; landing run, 40 m.; cruising range, 650 km. *Schweizer Aero-Revue*, May, 1944, pages 173–175, 3 illus.

Airports and Airfields

Fueling Systems for Airports. I. W. Baldwin. Adapted from a paper presented at the 1944 convention of the Aeronautical Institute of Canada, this is a survey of airport equipment for dispensing fuel to aircraft. In it the operating principles of hydraulic and mechanical pumping systems are outlined, the advantages and limitations of positive-displacement rotary, flooded-suction centrifugal, and submerged deep-well types of pumps are explained, and accessories used in modern fueling systems are described. Illustrating the construction and operation of different kinds of mechanical pumping units are details about four models manufactured by Bowser, Inc. One is a positive-displacement type of airport fueling system with a float suction which requires that all fuel be taken from the upper level. The second is a flooded-section centrifugal system in which the pumps are located below the level of the tanks and the fuel flows to them by means of gravity. The third system is a submerged one, employing a deep-well centrifugal type of aviation gasoline pump placed in the storage tank and driven by an explosion-proof motor. The fourth unit, called the "Serve-a-plane," is usable for dispensing oil as well as fuel; provides a fire extinguisher, sales slips, windshield cleaning utensils, etc.; and can be made automatic. All four units are illustrated by drawings. *Aero Digest*, August 15, 1944, pages 79–81, 133, 5 illus.

Ground Plans for Sky Trails. The planning of airports for postwar air transport is discussed. It is stated that airports should be planned by and for areas or regions rather than individual towns or villages, so that each community will obtain better service at the least possible cost. It is suggested that every community establish an airport planning committee to keep abreast of the changes in air transport and to translate them into improvements in airport facilities. The writer discusses the determination of the ultimate volume and type of traffic, the financial aspects of the program, the selection of the site, and runway patterns. *Air News*, September, 1944, pages 26–28, 72, 74, 13 illus.

Air Schools Lay Pattern for Postwar Traffic Technique. William D. Strohmeier. A detailed study of the pattern-flying system used by the Hawthorne School of Aeronautics for handling a large volume of air traffic around a concentrated airport area. Basis of the system is the standard rectangular pattern, modified by C.A.A. specifications, governing the arrival and departure of planes. It is suggested that lessons learned from air-traffic operations at Hawthorne, and similar school fields, indicate that radio control will not be necessary in the handling of heavy postwar civil aircraft traffic. *Aviation*, August, 1944, pages 192, 193, 273–277, 3 illus.

New Hemisphere Airports Unite the Americas. Norris M. Mumper. Some observations on the trends of airport expansion in the countries of the Western Hemisphere. It is shown that airport developments in Peru, Chile, Brazil, Nicaragua, Paraguay, Ecuador and Mexico, as well as in the United States, forecast extensive Latin American air traffic during the postwar period. The article includes notes pertaining to the increases in international air transportation that have taken place in the past few years, the peculiar adaptability of air travel for South and Central America, the operations of T.A.C.A. and affiliates in Central America, the different classes of airports, new markets that will be opened by air transport, and the supply of trained personnel that will supplement facilities in promoting the air-borne interchange of people and goods between the Americas after the war. *Western Flying*, August, 1944, pages 84, 86, 88, 93.

Airport Drainage. Edward Clement. Details are given regarding the drainage facilities provided for the Philadelphia Municipal Airport. It is noted that many runway and other airport-paving failures result from improper drainage. Information is furnished about the design of the runway system and the method of drainage. The storm drain discharge, outlet drain discharge, and outlet design are described. The layout of the airport and the drainage system are illustrated. *Aviation Maintenance*, August, 1944, pages 46–49, 3 illus.

Airfield Roads and Runways. This article contains information about the construction and use of Somerfeld Track and Somerfeld Flexboards. Employed as the basis for surfacing temporary airfields, the former is a membrane of wire netting stiffened laterally by steel rods at 9-in. centers. The lateral stiffening rods have a loop on each end through which the selvedge of the wire netting is stretched, the loops being subsequently closed and welded. Lending itself to speedy laying, this form of track is said to

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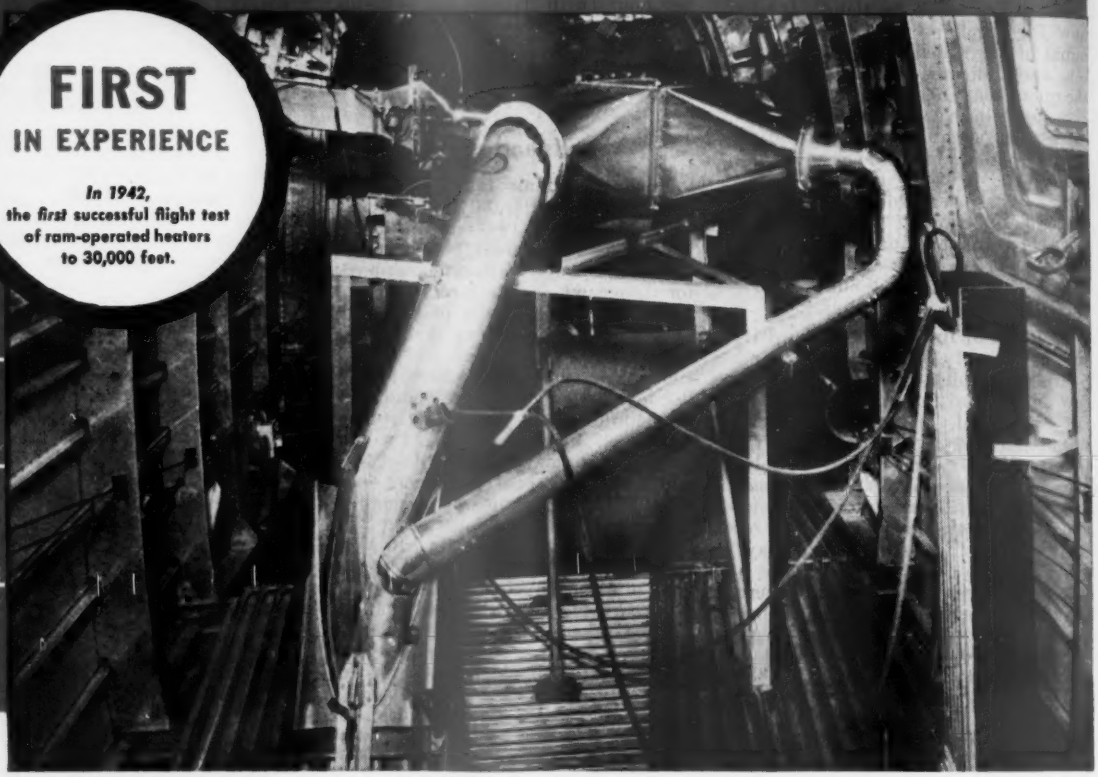

Test set-up for flight described below. COURTESY OF CONSOLIDATED-VULTEE AIRCRAFT CORPORATION

CRUDE and ungainly by present-day standards, the tube bundle type ram-operated heater shown above represented another South Wind "first" in the development of aircraft heating equipment. Installed in a B-24 Bomber for test purposes, it demonstrated that a ram-operated heater, completely independent of the aircraft engines, could operate under flight conditions at altitudes as high as 30,000 feet. In the Spring of 1942, that was news.

The results of this historic test flight were above expectations, with the result that plans were made for the first production installation of a ram-operated heater—the empennage anti-icing heater in the PBY airplane.

Improvements that put today's South Winds far ahead have followed steadily—and still continue. But again, that "famous first" showed South Wind FIRST IN EXPERIENCE, FIRST IN PRODUCTION, FIRST IN PERFORMANCE—a leadership that has yet to be seriously challenged!

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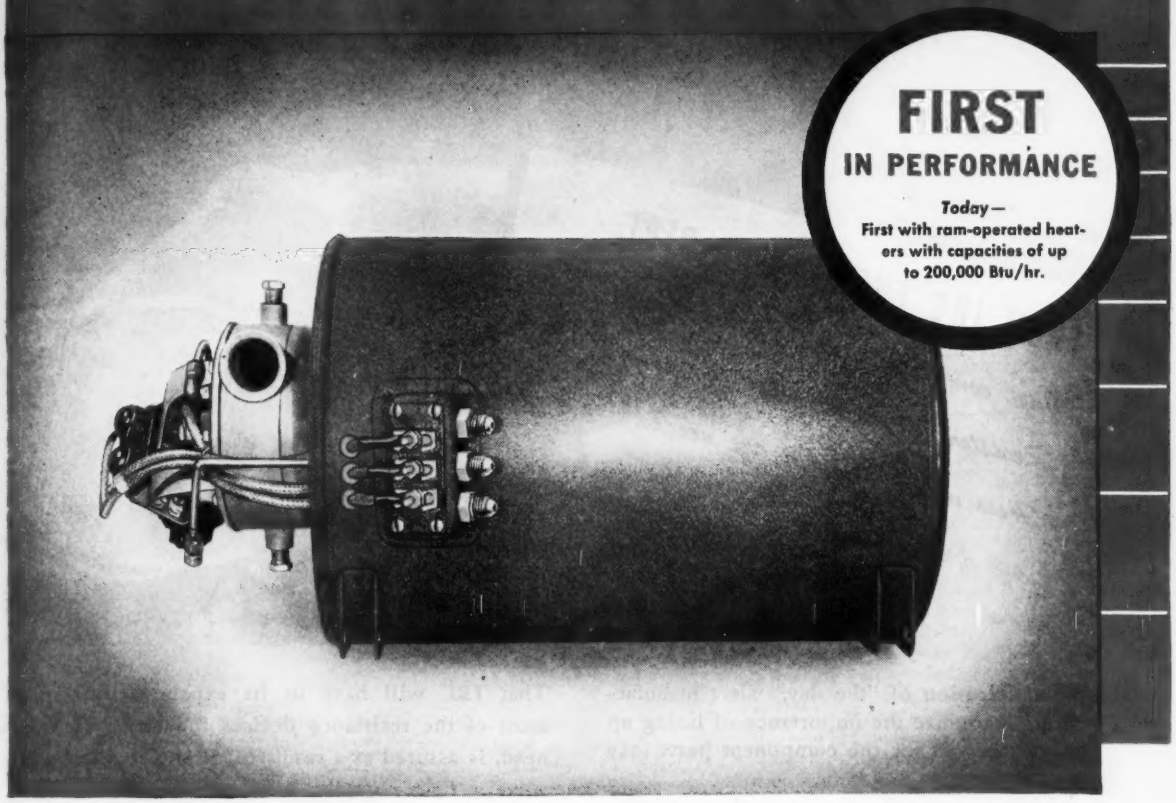

TODAY, South Wind's leadership in development of ram-air operation has resulted in a whole series of additional "firsts"... both in heaters and in important accessories like the South Wind Fuel Metering Control.

South Wind Model 911-A, for instance, with its revolutionary heat-to-weight ratio of nearly 10,000 Btu/lb., is an example of South Wind's leadership in performance today. Scarcely larger than an office waste basket, this dependable South Wind has been designed to be as simple and sturdy as could be—yet it can deliver over 200,000 Btu/hr.

Whatever your heating needs, South Wind engineers can put at your service more experience—more flight and laboratory data—higher-performance equipment than any other source. Call on South Wind for the engineering service, and production that has delivered more aircraft heating capacity than all other makers combined. Remember—South Wind is the "first" in heating.

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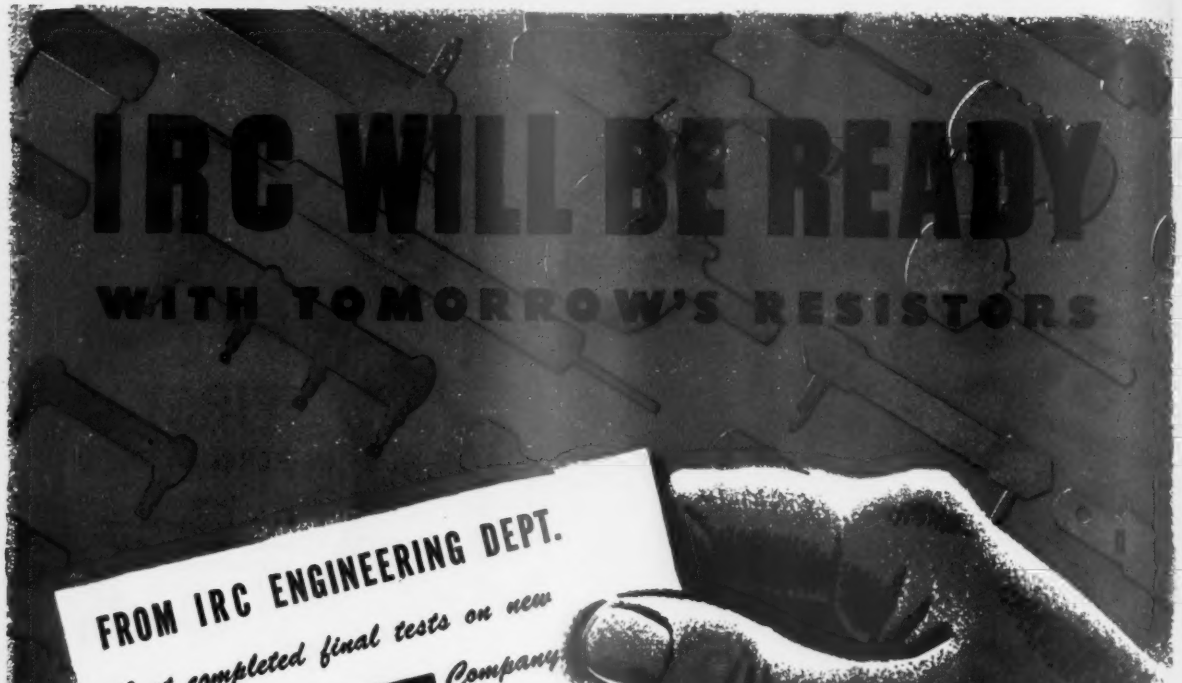
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That IRC will have in its expanded line most of the resistance devices industry will need, is assured as a result of careful market surveys. These quality units will be offered at prices consistent with mass production methods made possible through operation of the world's largest resistor plants.

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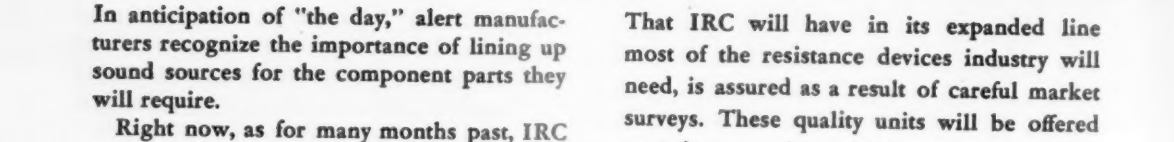
IRC makes more types of resistance units, in more shapes, for more applications than any other manufacturer in the world.



have exceptional load-carrying capacity, while at the same time it retains longitudinal flexibility, which permits the material to be rolled up.

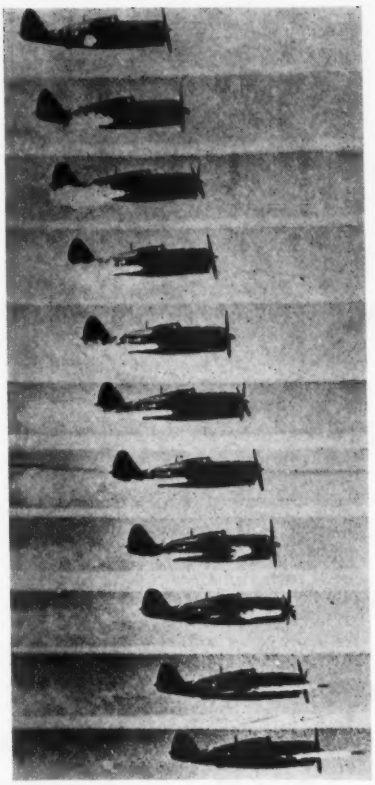
The Flexboards are reported to have been introduced as a complement to the wire-mat track, mainly as a means of providing an easily portable temporary road over virtually any type of ground. The principle of their construction is that of continuous, yet flexible, duckboarding. Boards are linked by mild steel ribbons, each board being attached through the ribbons with nuts and bolts. *Flight*, July 27, 1944, pages 101, 102, 5 illus.

Airports for the West. Part II. Second article in a series investigating the requirements for postwar airport facilities in the western part of the United States and discussing some of the problems involved in the establishment of those facilities. In this installment the need for a realistic approach to airport planning, based on consideration of current airplanes and those which it is reasonable to assume will be in use in the immediate postwar period, is stressed. Emphasis is also placed on the importance of the cost factor in any airport project. Recommended design standards for community airports are tabulated and a C.A.A. chart shows the effect of elevation on landing area utility. *Western Flying*, August, 1944, pages 58, 60, 4 illus.

Ska Edeby, Schwedens zukuenftiger Interkontinentaler Flughafen (Ska Edeby, Sweden's Future Intercontinental Airport). In anticipation of the postwar development of intercontinental aviation, it has been decided to prepare plans for a new Stockholm airport at Ska Edeby. Bromma, the only large Swedish airport, has already become too small. It is reported that the new airport will have an area of about 500 hectares (one hectare is 10,000 sq.m.). It will have six runways, each 2,000 to 3,000 m. long and 60 m. wide, while others will be 2,000 m. long and 40 m. wide. There will also be a seaplane base with a 200-m. dock, and six hangars which will have a floor space of 3,800 sq.m. each. The estimated cost will be 60 to 75 million kronas. *Schweizer Aero-Revue*, April, 1944, pages 134, 135, 1 illus.

"Snow Removal" Geng Tells How He Does It. Francis J. Geng. A review of experiments conducted at the St. Paul Municipal Airport during the past 17 years with different types of snow-removal equipment. The performance of the equipment and methods of snow removal are discussed. Based on the experience gained, the writer advocates four-wheel drive trucks with auger-type blowers. *Air Transport*, August, 1944, pages 74, 77, 2 illus.

How to Maintain Hangar Lights. The proper maintenance of hangar and shop-lighting systems is explained with the aid of a chart. Sections discuss the use of lamps of the correct voltage, the cleaning of bulbs and reflectors, and the repair of the lighting equipment. *Aviation Maintenance*, August, 1944, pages 74–86, 116, 13 illus.



The Republic P-47 Thunderbolt fires its new rocket gun. High-speed photos show, in chronological order, the first puff of smoke as the rocket is fired down to the last picture, where the rocket is clear of the plane.

Spotlight on San Antonio. Harry C. Reckner. This article contains information about the present activities of the military air-cargo center at San Antonio, Tex., as well as about plans for the expansion of the city's air terminal facilities after the war. Descriptive details are included on the "X-type" of building structure that will form the nucleus for future operations. The design calls for the grouping of terminal-building activities around a convenient central lobby. *Southern Flight*, August, 1944, pages 26, 27, 3 illus.

ATC's International Terminal. A description of the facilities and buildings of the Air Transport Command's new international air terminal, located at the Washington National Airport. The unit is reported to include passenger terminal and operations buildings, an air freight and mail building for priority mail and cargo, a portable steel hangar 200 ft. square, shops for plane servicing and maintenance, fueling facilities, 50,000 sq. yards of concrete ramp for plane parking, and an extensive parking area for motor vehicles. It is stated that the entire layout represents a logical approach to several important problems: (1) the expeditious movement of many types of air traffic through systems that do not cross, in order to eliminate confusion during peak-load periods of traffic, as well as during normal traffic-flow periods, (2) proper arrangement of administrative and operational activities in the sequence of their business flow, (3) the secondary servicing of passengers and pilots at the proper time and position in the flow of major processing, and (4) flexibility in space layout to permit revision and expansion. *Western Flying*, August, 1944, pages 82, 122, 124, 2 illus.; "Airport for Tomorrow," *Air Transportation*, July, 1944, pages 22–24, 3 illus.

Armament

Computing and Compensating Sights for Aerial Gunnery. Major Gen. Follett Bradley. An article discussing problems of aerial gunnery from bombers against enemy fighters. Reference is made to the difficulties involved in hitting an airplane in flight when shooting from another plane. Twelve variables that affect accuracy are listed. The development of computing and compensating sights is outlined and some remarks are made about the training of gunners. *Air Tech*, September, 1944, pages 23, 24, 2 illus.

The Future of the Robot Plane. Major Alexander P. de Seversky. Besides explaining in nontechnical language what the robot bomb is, the writer analyzes its value in air combat and predicts the future trends its development will take. He labels the flying bomb as just another kind of artillery and likens its employment to that of the water torpedo. He claims that robots are not a substitute for air power, that they cannot compete with a plane under human control, and that they cannot change the fundamental pattern of war.

While factors that limit the robot bomb in its present form are indicated, constant increases in the size, speed, and destructive power of this weapon are forecast. It is said that the robot will reach its greatest development in peacetime, its possibilities as a carrier of mail and other goods being described. *The American Mercury*, September, 1944, pages 322–325.

Airborne Rockets. Louis Bruchiss. Available information regarding the use of rocket weapons in the present World War is summarized. It is noted that the Russians were probably the first to announce the use of aerial rocket bombs suspended beneath the wings of aircraft, but the British have carried the technique well along in the installations on the Beaufighter. It is stated that just how American rocket equipment is being most effectively employed is largely a matter of conjecture at the present time, but that

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several American bombers and carrier-based planes have the structural durability and design adaptability that are prerequisite to the use of airborne rockets. Reference is made to the suitability of the Douglas A-20, the Martin B-26, and the North American B-25 for the installation of Rocket guns. The advantages of the rocket gun are outlined. *Air News*, September, 1944, pages 22, 23, 70, 71, 4 illus.; "Aircraft Rocket Guns," by Cecilia Stevenson; *Southern Flight*, August, 1944, pages 19–21, 5 illus.

Avigation

Graphic Solutions to Celestial Avigation. B. Mattson Compton. The writer's purpose is to propound certain formulas that, when added to existing material, are expected to increase the scope of application of celestial methods to a wider utilization of the classical fix as an aid to avigation.

A diagram shows the general construction, using graphic methods exclusively in determining the correct time to make a latitude check and track check. To eliminate the handicaps found in earlier methods of determining if the body is abeam, a mathematical formula is derived for each of the four possible conditions under which the problem will occur, and an explanation is given for a fifth possible condition. It is stated that the method produces accurate results, particularly when the sextant or octant reading is not less than 85° and when latitude is not more than 60° north or south. The four general conditions and the formulas are set forth. Adjustments are given to take care of slight variations in the conditions. The revised method is summarized under ten numbered steps. *Aviation*, August, 1944, pages 186, 191, 257–259, 8 illus.

Groundwork for a New Interpretation of the Problem of Air Navigation. Part III. Tappan Collins. Part III of a series of articles explaining the principles and operation of a proposed scheme of avigation called Flight Kinemetrics. This system is based on the concept of air navigation as a problem of multiple compound rotations. Its use invalidates the compass' interpretation of the direction of motion and requires instead a new method of instrumentation, the details of which are contained in the series of articles. In Part III the minimum final data necessary for computing free-ranging flight are identified. It is demonstrated how and why the indication of direction for an airplane in flight will be complete if three courses are recognized and related. These are the direction in which the airplane is aimed, the direction in which the airplane is moving, and the direction of reference. *Aero Digest*, August 1, 1944, pages 54, 55, 135, 4 illus.

Business and Finance

Insurance and Reinsurance. Raymond A. Lawrence. The recent progress of the aviation-insurance business is reviewed and new proposals are made for expanding and improving the coverage available for shippers and air-transport companies. Among the subjects considered are the efforts of Government authorities, participation of foreign insurance companies, the outlook for further legislation, and the need for trained personnel. *Air Transportation*, July, 1944, pages 12–14.

What Price Stocks Now That Cutbacks are here? Raymond L. Hoadley. A discussion of what effects stockholders may expect production cutbacks to have on the operating results of aircraft companies. Although accepting as fairly evident the fact that 1945 earnings of the aircraft industry will show considerable decline from the 1942–1944 average, the writer explains why aircraft manufacturers are not viewing with alarm the expected major production readjustments. He reviews measures being taken for avoidance of abrupt cancellations and indicates the advantage to the stockholder in a gradual, rather than abrupt, decline of aircraft equities from the March, 1944, peak. Favorable factors taken into consideration include tax refunds and the possibility of the aircraft industry's participation in a housing program. *Aviation*, August, 1944, pages 206, 278, 297, 1 illus.

Civil Aviation

A Marketing System for Our Airways. John E. P. Morgan. Taken from a paper presented at a recent Joint Airport Users Conference, this article stresses the need for a standard three-dimensional system of location markers in the United States which will adequately enable private pilots to orient themselves without navigational aids. It is urged that plans for such a system be initiated immediately by the C.A.A. to assure a uniform scheme throughout the country. While the writer does not recommend any particular marking pattern, he reviews several general suggestions that might be used in the project. A grid system for air maps, a scheme of marking that would coincide with the grid lines on the map, and possible types of markers are discussed. *Aero Digest*, August 15, 1944, pages 54, 55, 142, 2 illus.; "Am I Right for Topeka?" by Norman C. Updegraff, *Air Facts*, September, 1944, pages 78–81.

Law Enforcement Takes to the Air. John Edgar Hoover. The Director of the Federal Bureau of Investigation tells of the ways in which the airplane is utilized as an instrument of law enforcement. Besides providing a faster means of travel for agents on missions and speeding the transportation of exhibits and specimens from one locality to another, aircraft are used for various patrolling and detection activities. Instances in which the F.B.I.'s investigations were facilitated by airplanes are related. *Air Pilot and Technician*, August, 1944. pages 4, 5, 41, 2 illus.

Research Safeguards the Future. Oliver L. Parks. The writer expresses the belief that the time has arrived when the private citizen will make a utility of the private airplane. Reasons supporting the conviction are given. Figures are furnished on the training time for various age groups, which, it is stated, indicate that anybody can fly an aircraft of the helicopter type with an average of 5 hours of instruction. It is stated that recent technological advances in every department of aviation are making the small airplane a safe, dependable, and flexible means of personal transportation. A master plan for the establishment of landing areas is discussed. *The Draftsman*, August, 1944, pages 8–12, 9 illus.

Preparing for a New War. Keith Edgar. An account of an experimental project for solving the problems of spraying trees from aircraft. The problems, which are outlined, include the shattering of the liquid spray by the slipstream of the aircraft, the dispersal of the spray by wind, and the difficulty of obtaining the correct size of spray. Information is given about the special spraying apparatus being developed by the experimenters, the reasons for using "DDT" insecticide, and the scientists who are engaged on the project. It is reported that an autogiro was selected for the work. *Canadian Aviation*, August, 1944, pages 50, 51, 116, 6 illus.

Control Equipment

Push-Pull Aircraft Controls. Walter Stampfl. The operation, advantages, and applications of "push-pull" controls in the actuation of aircraft components are outlined. Push-pull controls are reported as being used on propeller governors, throttle, mixture, supercharger, bomb-bay door latches, carburetor, cargo-door latches, cowl flap, deicer, gunsight, landing-gear latches, remote hydraulic valves, and installations of similar nature. Among the factors that favor their use are considerations of weight, economy, restricted space, the need for more precise functioning, greater speed and ease of installation, and less vulnerability to gunfire.

The article contains notes on the lubrication of push-pull mechanisms. It also tells how the conversion of linear motion of the linkage in a push-pull control into rotary motion and the transmission of such rotary motion to an aircraft component can be accomplished by means of a device known as a "radian unit." *Western Flying*, August, 1944, pages 56, 57, 116, 7 illus.

Design

The Lockheed P-38 "Lightning." Hall L. Hibbard. No. 8 in the "Design Analysis" series, this detailed study of the Lightning's design and construction is presented by the Vice-President and Chief Engineer of Lockheed Aircraft Corporation. An engineering breakdown is given of each component and the special features characterizing the airplane are described. Specifications, performance figures, numerous schematic drawings, photographs, and tables of design data contribute to the comprehensiveness of the article. *Aviation*, August, 1944, pages 123–147, 43 illus.; "Design Analysis of the 'P-38' Lightning," by Joseph J. Johnson, *Industrial Aviation*, August, 1944, pages 7–20, 64, 105, 21 illus.

Aspects of the Design and Production of Airframes with Particular Reference to their Co-Ordination and to the Reduction of the Development Period. Eric Mensforth and W. E. W. Petter. A paper dealing with the problem of reducing the period of design of an air frame. The subject matter has application to all metal aircraft of medium size designed for military purposes. The writers describe the development and constructional stages through which an air frame passes with reference to particular examples and the derivation of an "ideal" program. Those features of organization having a particular bearing on the coordination of design and production are discussed. A number of main factors that affect coordination and speed-up development are described. Nine broad conclusions reached by the writers are listed. *The Journal of the Royal Aeronautical Society*, July, 1944, pages 210–259, 17 illus.

The Airlines and Future Transport Plane Design. W. W. Davies. An article on the types of aircraft that will be required for future air-line operations, with considerations of the research and analysis that must form the basis for development of the equipment. Problems involved in the designing of the necessary aircraft are specified and a program for properly analyzing these problems is outlined.

Establishing that the air liner of the future will be designed for a specific function, the writer offers a general idea of the extent of future air transportation and the kinds of markets to which it will cater. His figures are estimates gathered by United Air Lines. He also notes how United Air Lines analyzes these statistical data and translates them into preliminary designs for future transport aircraft. Other observations refer to specific plane types he thinks will be required for air-line operations 5 or 6 years after the war. *Aero Digest*, August 15, 1944, pages 56, 57, 134, 137, 2 illus.

Torsional Vibration Analysis of Systems Connected by Flexibly Mounted Epicyclic Gearing. R. G. Manley. In this paper the general dynamic stiffness method of analyzing torsional vibration problems is extended to apply to epicyclic gearing, allowance being made for the effect of flexibility in the gear housing. It is explained that a similar method may be used to allow for housing flexibility in normal spar gearing. *The Journal of the Royal Aeronautical Society*, July, 1944, pages 260–263, 7 illus.

'How About Designing Better Cockpits?' F. A. Spencer. Based on his experience as an air-transport pilot, the writer suggests principles that the designer should hold in mind when laying out the cockpit in the postwar air liners. These are summarized as: (1) adequate cockpit lighting; (2) functional instrument panel; (3) low noise level; (4) comfortable seats; (5) even heating and ventilating; (6) central radio control; (7) all-weather visibility; (8) functional levers and handles; and (9) no rough edges. *American Aviation*, August 1, 1944, pages 66, 68, 70, 1 illus.

Takeoff Analysis for Flying Boats and Seaplanes. Part I. Ernest G. Stout. This article has been prepared in an effort to eliminate a large portion of the conflicting procedures involved in the accurate prediction of the performance of flying boats and seaplanes during take-off. The writer, Staff Engineer in charge of Hydrodynamics Development of Consolidated Vultee

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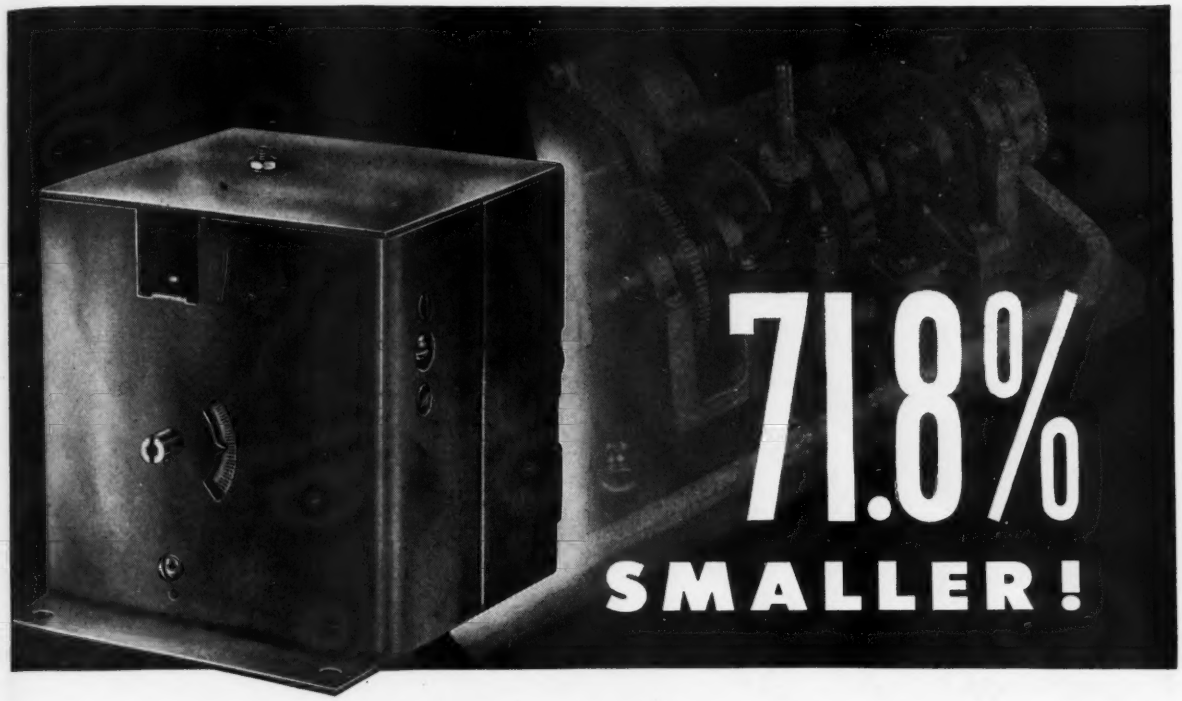

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Aircraft Corporation, divides the take-off run into four speed regimes, one blending into the next, in which the flow patterns show marked differences. The first stage is called the displacement stage or "ploughing stage." The second, the "transition stage," occurs when the relative speed between the water and the step increases, and contact between the water and the afterbody of the craft moves progressively aft. The third stage is a period of pure planing on the forebody alone, during which the entire hydrodynamic reaction is confined to the planing bottom ahead of the step. The fourth stage is the period when the craft becomes air borne, when the planing trim must be adjusted to the proper attitude for "getaway," or take-off.

The forces prevailing in each of these stages are defined and analyzed. The application of the equations of motion, the hydrodynamic nondimensional coefficients, and the aerodynamic ground effects are explained, with the necessary mathematical computations. A step-by-step outline of the procedure is given. A table shows an example of the calculation of ground effect, and another table is a suggested form for recording the take-off computations. *Aviation*, August, 1944, pages 150–153, 251, 4 illus.

Fuselage Shells. F. J. Wingfield-Digby. This is a technical comparison of thick- and thin-skin monocoque construction. The writer advocates the use of thicker skinning on small types of aircraft where, because of the small size of the fuselage, the ratio of curvature to thickness of the skin (r/t) can be made such as to allow a reasonable stress to be developed without the necessity of supporting the skin with numerous stiffeners. By means of analysis he shows why the following advantages can be expected from thick unstiffened monocoque construction in magnesium or Duralumin if the r/t values are such as to allow for its use economically: (1) gain in speed; (2) simplification in construction, and cheaper and easier production; (3) possible slight saving in weight where the fuselage is of small dimension and approximating a circular section; (4) greater torsional rigidity. *Flight*, July 6, 1944, pages 17, 18, 20, 4 illus.

The Hillson Bi-Mono. This is a review of the design, construction; and performance capabilities of an experimental aircraft incorporating the "scrap-wing" principle of assisting heavily loaded aircraft to become air borne. The design is based on the idea of lowering the wing loading at take-off by adding another wing, which is discarded when the airplane has reached its economical cruising height. Specifications of the Hillson airplane are listed and the results of its flight tests, both as a biplane and a monoplane, are reported.

In a consideration of possible future application of the "scrap-wing" principle, disadvantages of the type are demonstrated. It is stated that the future of the scrap-wing airplane seems uncertain because large variations in wing area must lead to bad effects on stability and control and because of the difficulties involved in jettisoning the wing so that it can do no damage to persons beneath. A form of "slip wing" or an inverted Mayo composite is suggested as a more desirable alternative. *The Aeroplane*, July 7, 1944, pages 14, 15, 11 illus.

Post-War "Air Commuter." The design features of the York Air Commuter are reviewed. This is a proposal for a four-place, twin-engined, high-wing, utility landplane. Of mixed molded plywood and metal structures, this airplane is likened to a station wagon. It may be used for either cargo or passengers. With a special arrangement of its cabin space, provision is made for carrying a small light car. Airplane controls are so designed that they do not interfere with the car. Possible uses suggested for this airplane include intercity mail service, utilization by company sales and executive personnel, intercity air express, fire-fighting equipment carrier, private and sports use, ambulance for rural areas, and police patrol work. Specifications are listed for both the plane and the specially designed car to be used in it. *Aero Digest*, August 15, 1944, pages 89, 224, 5 illus.; "Flying Station Wagon," *Automotive News*, September 4, 1944, page 8, 3 illus.

A Method for Calculating Weights of New Flaps. John B. Scalzi. A method is suggested for estimating the weight of newly designed flaps that have approximately the same area and load as an old design, but in which the geometry is different from that previously used. The writer analyzes the loads acting on the structure and derives a mathematical sequence by which the weight of the new flap design can be calculated by the use of the relationship between the material and the load it must sustain. This computation indicates that the weight per square foot varies directly as the loading and cube of length, and inversely as the height. A method is developed also for verifying the correctness of the calculations by actual trial on existing flaps. The writer states that his experience has shown that the error is usually within a range of values from 10 to -10 per cent, and that a variation of this magnitude is permissible in preliminary estimates of structural groups of large proportions. It is noted that the expression developed does not include any balance weight when applied to ailerons, only the structural weight being considered in the derivation. A method for estimating the balance weight is outlined. Instructions are given for the application of the derived expression to the work of the weight engineer. *Aviation*, August, 1944, pages 155, 277, 278, 1 illus.

The "Catalina" PBY5A Flying Boat. Part I. The characteristics of the PBY-5A are examined in detail. In this introductory article of an engineering-analysis series, data are given on the power plant, propellers, starting system, and lubricating system of this latest version of the Catalina flying-boat. Schematic drawings illustrate particulars of the engine, propeller installation, auxiliary power unit, oil system, power-distribution system, main hydraulic system, power-plant controls, instrument panel, and center-section leading edge of the wing. *Aero Digest*, August 15, 1944, pages 90–95, 12 illus.

Electrical Equipment

Differential Generator Control Relay for D-C Aircraft Electric Systems. F. E. Crever. The writer discusses the features of a differential type of generator control relay that is not subject to chatter. The device has been developed and tested in flight on a system having four main engine-driven generators and an auxiliary power plant. It is stated that this type of relay has been shown to be practical and advantageous when used on a system having voltage regulators with equalizers. *Electrical Engineering*, August, 1944, pages 589–592 (Transactions), 10 illus.

Transport Blinkers. Alan L. Morse. A review of how and why the present system of aircraft position lights was devised. As related, the problems faced at a meeting called by the Safety Bureau of the C.A.B. in 1941 were the development of an improved taillight of suitable brilliance and conspicuousness, development of an auxiliary forward position light particularly for transport planes, and a long-range program covering position lights generally. It is told how requirements were met by a system consisting of a red and white light on the tail and red and green wing-tip lights all flashing at a rate of 40 cycles a min. The time of flashing is: red light on 0.625 sec. followed by a period of darkness of 0.208 sec.; white light on 0.625 sec. followed by darkness of 0.042 sec. Groups and specialists who participated in the work of developing this scheme of aircraft position lights are noted. *Flying*, September, 1944, pages 53, 140, 144, 3 illus.

Aircraft Fuses Must Protect. John C. Lebens, Jr. A review is given of the evolution of the electric system in aircraft, which, it is noted, has paralleled the development of the airplane itself. The writer analyzes the function of fuses and other protective devices and describes equipment that has been used to obtain more complete electrical protection in aircraft. Sections of the article discuss fusing requirements, protection equipment, and circuit protection. *Electrical Engineering*, August, 1944, pages 581–585, 3 illus.

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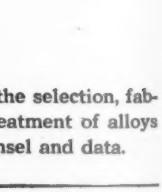

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Engines

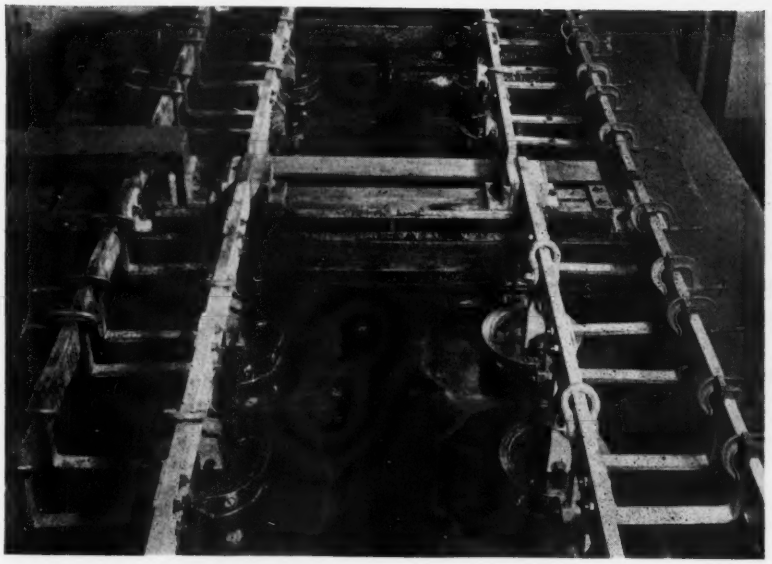
Production Thread Gauging. A gauge for measuring the effective diameters of threads on aircraft-engine cylinder barrels is described. By providing a constant application pressure, this device is said to eliminate difficulties previously experienced because of the lack of sensitivity resulting from a combination of the light section of the tubular component being gauged, the weight of the conventional gauge, and wear, and because of the necessity for grading the work to ensure close control of shrinkage allowance without demanding excessively close machining tolerances. It comprises a base on which is mounted an adjustable block, housing a thread roller of the Newall type. A second thread roller, housed in a slide, can move radially with respect to the component, against light spring pressure, in a block secured to the base. A dial indicator calibrated to 0.0001 in. is fixed to the block and registers movement of the slide.

The article also describes and illustrates a similar fixture that is being used for checking screwed valve inserts. This fixture embodies full-form and relieved thread elements and width gauges. *Aircraft Production*, August, 1944, page 404, 2 illus.

Engine Mountings. Maurice F. Allward. Beginning of a series of articles discussing the features of engine-mounting design and surveying various types of engine mountings used for military aircraft. This first article notes the reasons for differences in mountings, examines basic design and construction considerations, differentiates between structures developed for radial engines and those developed for in-line engines, and outlines the problem of engine-mounting stressing. It also reviews the special characteristics of the mountings used for two German airplanes, as well as one British and one Japanese. The planes are the FW 190A3, Do 217e2, Bristol Hercules, and Mitsubishi S-00. *Flight*, July 27, 1944, 91–93, 3 illus.

The Mercedes-Benz DB.605 Al Engine. A Russian account of improvements made in the Mercedes-Benz DB.605 Al engine. The article is taken from the U.S.S.R. Air Fleet Technical News. The basic details of this model are tabulated and details are also given for all the wartime modifications of the Daimler-Benz engine. *Aircraft Engineering*, July, 1944, pages 190, 202, 6 illus.

Lengthening Piston Ring Life by Porous Chromium Plating. Tracy C. Jarrett. A porous chromium plating process is described which is said to increase piston-ring life approximately five times and to reduce wear to about one-third of that obtained with unplated rings. Applied to the cylinder contacting surface of the piston ring, the plate is said to permit the ring to seat itself immediately without lapping. It is noted that for an aircraft engine only the top ring of each piston is chromium plated. Tables show the barrel wear of different types of aircraft engines, some provided with plain cast-iron rings in the top groove, and others with porous chromium-plated rings in the top groove; the hardness of the chromium plate remaining at the conclusion of the test period; and the approximate amount of wear on the chromium-plated ring. *Industrial Aviation*, August, 1944, pages 46, 62, 3 illus.



Photograph Courtesy American Hammered Piston Ring Division, Koppers Company

Chromium plating arbors of piston rings. Twelve arbors can be plated at the same time.

The Opposed-Piston Engine. R. H. P. Nott. Some observations concerning the possibilities of opposed-piston two-stroke engines for aircraft. Limitations that preclude the use of this type of engine in airplanes are given primary importance in the article. Some of the disadvantages examined are those concerned with the length in one plane of such engines and the necessity for installing them horizontally in the wing, mechanical efficiency, scavenging efficiency, supercharging, the need for direct fuel injection, and cooling problems. However, it is stated that the success of the monosleeve valve for four-stroke engines may open renewed possibilities in the two-stroke sphere by virtue of its adaptability to a variety of port arrangements and its simplicity of operation. *Flight*, July 13, 1944, page 48.

The Utilization of Exhaust Thrust. N. Ya. Litvinov. A translation of an article taken from the U.S.S.R. Air Fleet Technical News. A comparison is made between the jet thrust obtained by means of a capacity-type exhaust manifold connecting several cylinders and by means of separate reaction-type exhaust pipes, fitted one to each cylinder. Curves are presented showing the mean thrust for pulsating and continuous types of exhaust, the variation of the exhaust thrust with the altitude of the aircraft, a dna comparison of the altitude characteristics of the engine with and without the use of exhaust thrust, by separate exhaust pipes and by the capacity-type manifold. A final curve shows the results of comparative flight tests with separate exhaust pipes, with the single manifold, and with separate exhaust pipes, the exit sections of which were 30 per cent less than the optimums.

The calculations indicate the following: (1) The increase in speed at ground level with separate exhaust pipes and under optimum nozzle-exit conditions is slightly greater. (2) The thermal loading of the separate exhaust pipes is less than in the case of the manifold because of the intervals between the successive exhaust strokes. Under night flying conditions, therefore, there is less risk of observation and the pilot is less likely to be dazzled by the glare. (3) The weight of the separate exhaust pipes is less than that of the capacity-type manifold. (4) The reaction-type exhaust system in the form of separate exhaust pipes allows the exhaust energy to be utilized with a higher relative efficiency, with less weight, and with less risk of observation under night-flying conditions than the capacity-type manifold. *Aircraft Engineering*, July, 1944, pages 188, 189, 5 illus.

The Development of the Merlin Engine. J. E. Ellor. Steps in the development of the Rolls-Royce Merlin are reviewed by the Chief Research and Development Engineer of Rolls-Royce, Ltd. It is noted that, while the first Merlin engine was developed only a little over

10 years ago, its design was based on the Rolls-Royce engines that had already been successfully built, including the widely used Kestrel engine, the present-day Merlin being a direct scale-up of this engine. The general trend in improving engine performance is discussed. These have taken the form of such changes as alternate supercharger and airscrew reduction gear ratios, stepped-up power ratings and supercharger performance, and improved cylinder cooling attained by changing over from pure glycol to pressure-cooling systems. The limitations imposed on the degree of supercharging by detonation are pointed out, and the effect of raising the mean effective pressure in the cylinder is discussed. It is stated that 15 years ago mean effective pressures of 150 lbs. per sq.in. from engines having a weight/power ratio of 1.8 were considered good, whereas today, on virtually the same engine, the maximum mean effective pressures attained have been increased to between two and three times, and the maximum weight/power ratios have been reduced to less than one-half the former figures.

Factors influencing the limitations on increased mean effective pressure are listed in their order of importance. It is stated that increased supercharger pressure raised the sea-level power of the Merlin by 40 per cent, giving the pilots of the Spitfires advantages over the German fliers. Sections of the article deal with early developments, the development of the interchangeable power plant, exhaust-valve corrosion, cylinder heads, supercharger design, factors affecting power output, and the details of the Merlin 61. *SAE Journal*, August, 1944, pages 385–392 (Transactions).

Fighting an Implacable Foe. The deleterious effects of dust upon aircraft engines, some of the filtering problems involved in combating this condition, and desirable characteristics in aircraft-engine filters are described. The article tells of an exhibition in which Voke type filters were demonstrated. Relating the principles of operation upon which these filters are based, it states that one of the main reasons for their success is the use of a large filtering element area in proportion to the volume and velocity of flow. *Flight*, July 20, 1944, page 71, 1 illus.

Flight Technique

Check Ride. E. C. Bailly. In a general outline of a check-ride, the writer indicates some of the primary things for which the check pilot will be looking and offers suggestions to the student on how to avoid faults that occur most commonly in such examinations. The advice offered pertains, among other things, to simulated forced landings, cockpit procedure, correct posture, stalls and spins, relaxation, keeping within an assigned flying area, avoiding other planes, entering traffic, and approaching the field. Emphasis is placed mainly on what to do in simulated forced landings. *Air Facts*, September, 1944, pages 68–70, 72–74.

Fuels

A Correlation of the Temperature—*V/L* Characteristics of Motor Gasolines with Inspection Test Data. E. W. Aldrich, E. M. Barber, and A. E. Robertson. In this paper the results of an investigation of the vapor-forming characteristics of gasoline are given in the form of a correlation whereby vapor-forming characteristics can be estimated from the customary gasoline inspection test data. It is stated that these results are applicable in considering vapor-lock test data when it is important to know the vapor-forming characteristics of the gasolines employed in the test and, in particular, when it is necessary to apply vapor-lock test results to fuels other than those directly employed in testing. *SAE Journal*, August, 1944, pages 364–367 (Transactions), 3 illus.

Gliding and Soaring

Improved Efficiencies in Glider Structures and Operating Costs per Ton Mile with Cargo Gliders. Innes Bouton. The writer discusses cost reductions obtainable through the use of gliders in conjunction with powered aircraft. Reference is made to cargo gliders that have been used by the Army Air Forces. It is stated that the CG-13 and CK-10A have many attributes necessary for commercial flying of the future and that these new gliders are capable of hauling more cargo than any airplane of comparable size.

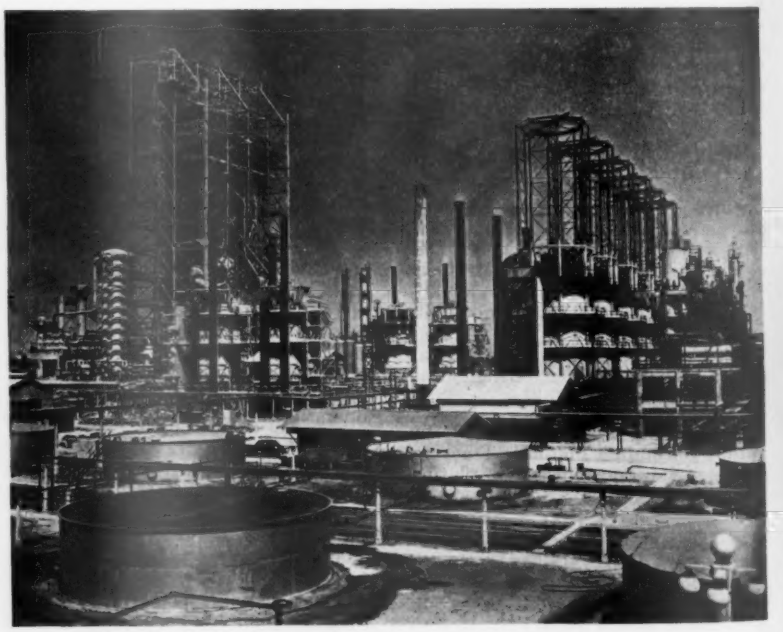
The operating costs for a train consisting of a hypothetical 18,000-lb. gross weight glider towed by a DC-3 are compared to the costs for the DC-3 alone. Curves are presented which show a reduction in operating costs of approximately 50 per cent for the glider train over the DC-3 alone. The costs are figured on a 100 per cent load factor. The assumptions made in calculating the costs are listed. Structural economies possible in glider construction and future developments in the use of cargo gliders are discussed. *Gliding*, August, 1944, pages 9, 14, 15, 20, 3 illus.

The Great Glider Era Is Just Beginning. Col. Edward S. Evans. A biographical sketch of Col. Edward S. Evans' work in the encouragement of gliding. The writer reviews the early days of gliding and also discusses glider developments of the future. *Gliding*, August, 1944, pages 10–13, 5 illus.

History

Charles F. Durant . . . Early American Aeronaut. Max Kronstein. An outline of the activities of the early American aeronaut, Charles Ferson Durant. A balloon ascension he made at Castle Garden on September 9, 1830, and later ascensions are described. It is stated that he was the first United States citizen to become a professional aeronaut, the first person to use balloons made in America, and the first to use air leaflets in America. *The Airpost Journal*, August, 1944, pages 316–321, 2 illus.

Of Kassel and Schönefeld. Parts I and II. Parts I and II of a continued



A section of the recently completed Richfield Oil Corporation's "100-plus" octane refinery near Los Angeles.

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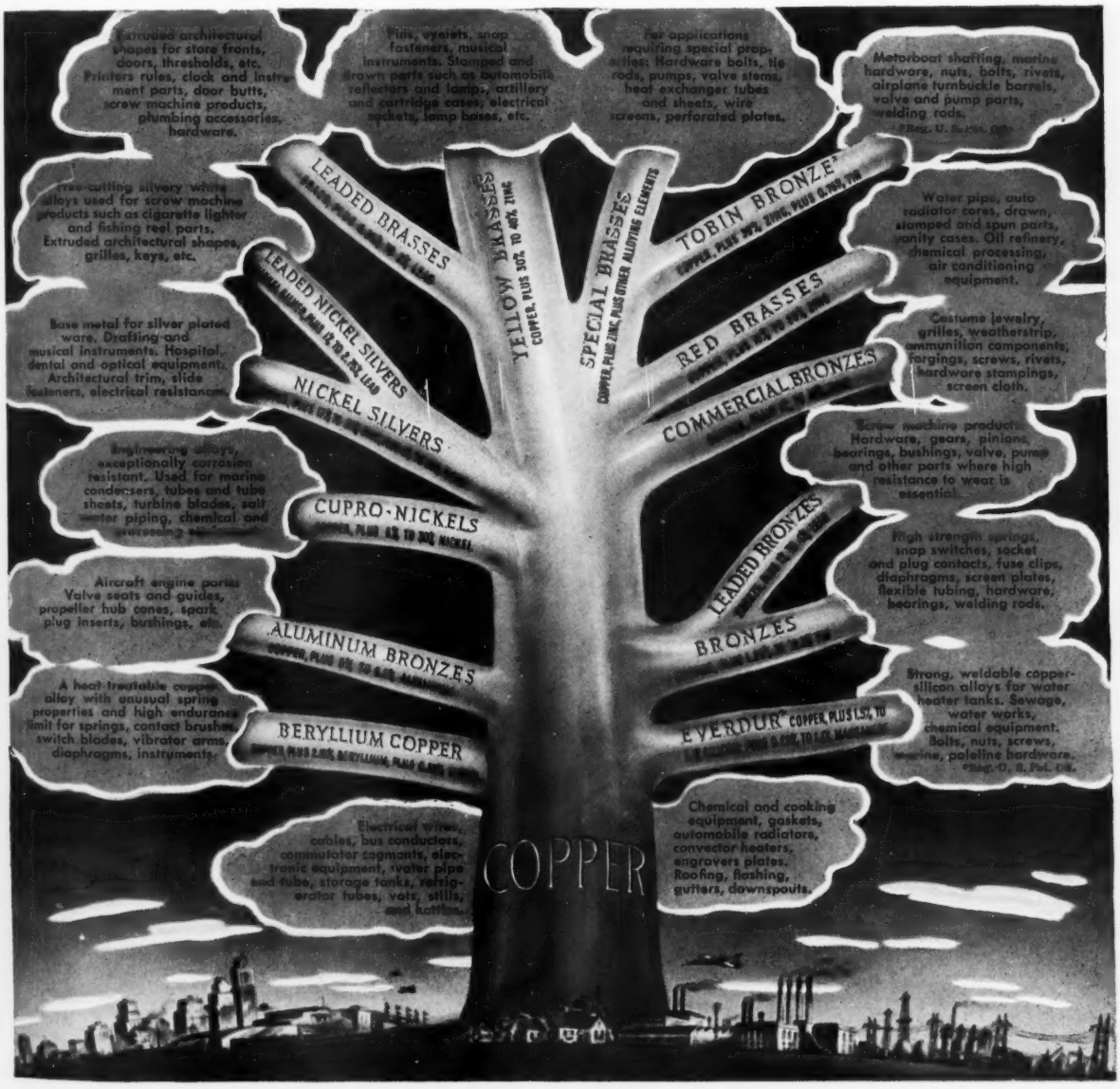
Extruded architectural shapes for store fronts, doors, thresholds, etc. Printers rules, clock and instrument parts, door butts, screw machine products, plumbing accessories, hardware.
Pins, eyelets, snap fasteners, musical instruments. Stamped and drawn parts such as automobile reflectors and lamps, artillery and cartridge cases, electrical sockets, lamp bases, etc.
For applications requiring special properties: Hardware bolts, tie rods, pumps, valve stems, heat exchanger tubes and sheets, wire screens, perforated plates.
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LEADED BRASSES
YELLOW BRASSES
SPECIAL BRASSES
TOBIN BRONZE*
Water pipe, auto radiator cores, drawn, stamped and spun parts, vanity cases. Oil refinery, chemical processing, air conditioning equipment.
LEADED NICKEL SILVERS
RED BRASSES
Base metal for silver plated ware. Drafting and musical instruments. Hospital, dental and optical equipment. Architectural trim, slide fasteners, electrical resistance.
NICKEL SILVERS
COMMERCIAL BRONZES
Costume jewelry, grilles, weatherstrip, ammunition components, forgings, screws, rivets, hardware stampings, screen cloth.
Engineering alloys, exceptionally corrosion resistant. Used for marine condensers, tubes and tube sheets, turbine blades, salt water piping, chemical and
CUPRO-NICKELS
Screw machine products. Hardware, gears, pinions, bearings, bushings, valve, pump and other parts where high resistance to wear is essential.
LEADED BRONZES
High strength springs, snap switches, socket and plug contacts, fuse clips, diaphragms, screen plates, flexible tubing, hardware, bearings, welding rods.
Aircraft engine parts: Valve seats and guides, propeller hub cones, spark plug inserts, bushings, etc.
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BRONZES
A heat treatable copper alloy with unusual spring properties and high endurance limit for springs, contact brushes, switch blades, vibrator arms, diaphragms, instruments.
BERYLLIUM COPPER
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Strong, weldable copper-silicon alloys for water heater tanks. Sewage, water works, chemical equipment. Bolts, nuts, screws,
Electrical wires, cables, bus conductors, commutator segments, electronic equipment, water pipe and tube, storage tanks, refrigerator tubes, vats, stills,
COPPER
Chemical and cooking equipment, gaskets, automobile radiators, convector heaters, engravers plates. Roofing, flashing, gutters, downspouts.

ANACONDA from mine to consumer

Anaconda Copper & Copper Alloys

The Scope of

(continued from preceding page)

manganese, silicon, beryllium, chromium and other elements, and that each alloy is produced in a wide variety of commercial sizes and shapes, the need for strict laboratory control of all materials and every step of production becomes readily evident.

2,506,329 Laboratory Tests made in 1943

The scope of routine laboratory control over all mill operations and practices can be gaged by the number of tests made during 1943 in the laboratories of The American Brass Company—2,506,329. This includes tension and bend tests, conductivity or resistance tests, examinations under the chemical and metallurgical microscopes, and chemical and spectrographic determinations.

Examining a spectrum plate. The presence or absence of various elements is determined by matching a master plate with the unknown spectrum. Semi-quantitative analysis can be made by comparing the relative intensity of element lines in the sample spectrum with those in exposures of standard samples made on the same plate.

CHEMICAL AND METALLOGRAPHIC LABORATORIES

A. Electrolysis is utilized for the accurate and rapid determination of copper and certain other elements in copper alloys. In this apparatus, platinum anodes are mechanically rotated. The exact weight of copper after deposition and drying is quickly indicated by the latest type Projection Reading Analytical Balance. Determinations of copper and lead contents, for instance, can be made in less than an hour. **B.** The American Brass Company pioneered in its field in the use of colorimetric methods of analysis. The Photo-Electric Colorimeter illustrated accurately determines amounts of certain constituents of copper base alloys—in minutes, instead of hours formerly required by the usual wet methods of analysis. **C.** Control of grain structure is important in obtaining the required physical properties of copper alloys. Here, on the Grain Size Comparator, the diameter of average grain of a brass specimen is being determined by directly comparing the magnified image of the specimen with "transparencies" of known standards. **D.** The preparation of all types of specimens and the production of photomicrographs at medium and high magnifications require a high order of skill and experience in operating the metallographer's most useful tool —the Metallurgical Microscope. In technical circles an enviable reputation has been earned by The American Brass Company for the excellence of its photomicrographs. . . . But before microscopic examination can be made, the specimen must be carefully polished and etched to reveal the essential details. An electrolytic method of doing this had been brought to a high state of development by The American Brass Company, and routine use for a period of several years has proved its advantages over the slower method of mechanical polishing and chemical etching.

ANACONDA
from mine to consumer

Anaconda Copper & Copper Alloys

TECHNICAL CONTROL over Anaconda Alloys

Such extensive application to technical details—plus the craftsmanship inherent in more than a century of experience in the art of making brass—have led the way in producing Anaconda Alloys possessing unusual uniformity and dependability.

Foremost in Research

You would expect the largest fabricator of copper and copper alloys to be foremost in the search for greater metallurgical knowledge in that field:

As early as the turn of the century, The American Brass Company instituted routine laboratory control of alloy compositions, replacing the father-to-son methods of mixture determination which up to then had prevailed throughout the Industry.

In 1902, the trend toward more accurate control of grain size and structure was initiated through the use of the metallurgical microscope.

In 1914, a large quartz spectrograph was installed, the first in this country to be used for metallurgical research and qualitative analysis of alloys.

The Research Department of The American Brass Company has produced and tested thousands of copper base alloys, many of which are now in common use for special types of service, providing higher strength, greater workability, and better corrosion resistance than ever before available.

It has often combined in one alloy the specific properties of several others, providing an opportu-

(continued on next page)

RESEARCH AND SPECTROGRAPHIC LABORATORIES

Operations performed in the spectrographic analysis of metals are of three types: Qualitative—in which the identity of the elements alloyed to form the sample is established; Quantitative—in which the presence of certain elements is confirmed and the amount of each measured precisely; or Semi-Quantitative — in which certain elements are identified and the amounts estimated by comparison with standards representing the specification limits. E. In this quartz prism spectrograph, radiation from the arc passes through the slit and is dispersed by the large quartz prism to form on the photographic plate an image of the slit for every wave length present in the arc. Each element "writes its signature" on the plate—positive proof that the element responsible for those lines is present in the sample. F. Rather than by a prism, dispersion of the radiation passing through the slit on this grating-type Spectrograph is obtained by a diffraction grating ruled on a concave mirror. The spectral lines characteristic of each element vary in intensity in proportion to the amount of the element present in the sample. G. This Densitometer-Comparator is being used for examination of spectra taken on the grating-type Spectrograph. A magnified image of the spectrum appears on the screen, and is compared with a master plate imaged on the lower third of the screen. H. This X-ray Diffraction Unit has a wide variety of research applications: Determinations of the amount and type of preferred orientation; identification of phases, and determination of their lattice parameters are a few. Certain mill operations also are brought under more rigorous control with its aid.

Made by The American Brass Company

PLANNED RESEARCH is finding the answers to many metal problems

(continued from preceding page)

nity for manufacturers to reduce production costs, simplify tooling requirements, and increase the serviceability and value of their product.

It has developed mill procedures to facilitate production and assure quality.

It has developed readily weldable copper base alloys, welding rods, and procedures for their use—making possible the economical use of strong, corrosion resistant, lightweight assemblies where more cumbersome castings of rustable metals were formerly employed.

Answers to other metal problems have been found in the development of strong, ductile, workable alloys of brass, bronze or nickel silver—with composition, temper and grain size adjusted to provide the best combination of characteristics for operations such as spinning, stamping, cupping, forming, deep drawing or machining. Resulting economies include longer life for dies and cutting tools, greater uniformity of parts, product improvement, and a lower over-all manufacturing cost.

The goal of this painstaking laboratory control and planned research program is that the Anaconda Copper or Copper Alloys you select will fully meet your manufacturing requirements and the service standards of your product—that they will be moderate in price, economical to use, and wholly adequate to your needs.

The Technical Department of The American Brass Company will be glad to work with you in selecting the best metal for a specific application.

ANACONDA from mine to consumer

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut • Subsidiary of Anaconda Copper Mining Company

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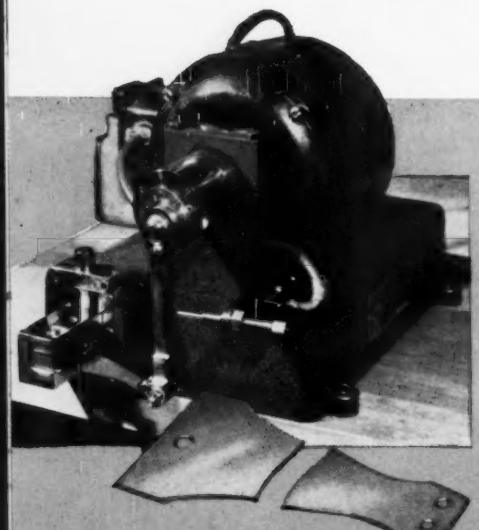
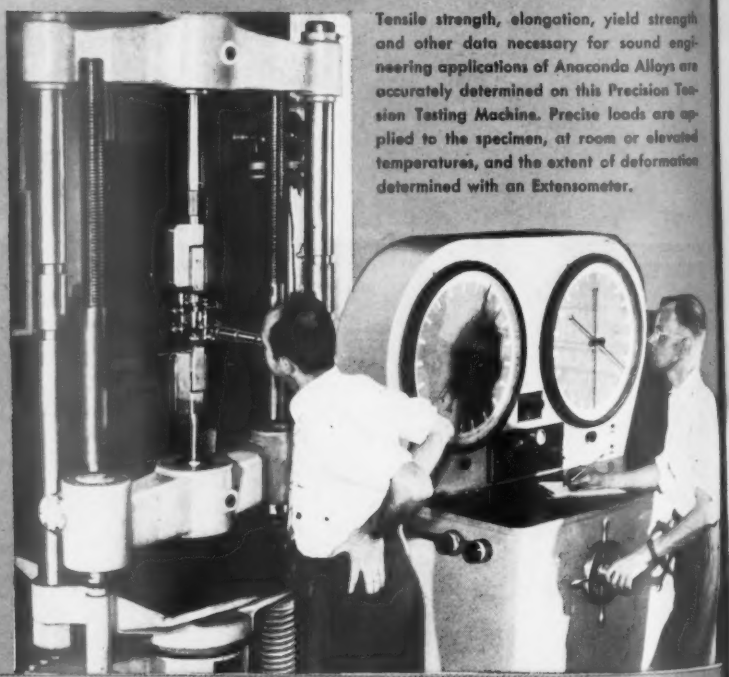


TESTED TO DESTRUCTION—

—so that Anaconda Metals in service may have longer life. Performance of Anaconda Alloys in simulated service is constantly checked in the Testing Laboratories. This broken phosphor bronze strip fatigue specimen withstood approximately 50,000,000 cycles of reversed stress, on the Fatigue Machine illustrated, at a deflection corresponding to an initial stress of 25,000 lb. per sq. in. before failure occurred.

SECTION OF PHYSICAL TESTING LABORATORY

Tensile strength, elongation, yield strength and other data necessary for sound engineering applications of Anaconda Alloys are accurately determined on this Precision Tension Testing Machine. Precise loads are applied to the specimen, at room or elevated temperatures, and the extent of deformation determined with an Extensometer.



Anaconda Copper & Copper Alloys

SOMETHING BIG— like lifting an ELEPHANT

A NEW, strange feature of the American Scene—those Flying Elephants in the neighborhood of vital war plants . . .

At night they are moored from ten to twelve thousand feet up—the better to clip your buzzard's wings, Tojo! With the mooring cable, a barrage balloon weighs about 1,350 pounds. It takes a lot of LIFT—12,000 cubic feet of HYDROGEN—to do this job!

Scientists at the "University of Petroleum," Shell's research laboratories, got hydrogen as a by-product when they discovered how to make smokeless powder components from petroleum gases—hydrogen to lift these flying Elephants!

Thus—one more outstanding contribution to America's war effort from Shell.

* * *

Shell was first, too, to supply American military aviation with a super fuel—100-octane gasoline—giving our planes new speed, flying range, and tactical advantage. Later Shell discoveries vastly increased both the power and production of aviation gasoline.

Today, more Shell 100-octane aviation fuel is supplied to aircraft engine manufacturers, for critical test and run-in purposes, than any other brand.

And now, each day, Shell produces more than enough to fuel a bombing mission of 2,400 planes from England over Germany.

Farsighted airport operators will find Shell's wartime popularity a profitable peacetime asset.

SHELL

FINER FUELS FOR THE AGE OF FLIGHT

article giving the history of the German firm of Henschel. It is noted that the original Henschel Company started to build locomotives in 1848. Other products built by the company during the last World War are mentioned. The first Henschel airplane was built by a branch of the company at Kassel in 1933. A step-by-step description is given of the many types of aircraft built by the company from that time on. *The Aeroplane Spotter*, July 13, 1944, page 161, 5 illus.; July 27, 1944, pages 172, 173, 12 illus.

Inspection

Importance of Film Processing in X-Ray Inspection. Robert Taylor. In a discussion of the proper methods of processing the films used in X-ray inspection, emphasis is placed on the care that should be taken in handling the film. Various defects that may appear in the finished radiograph are analyzed as to cause, and advice is given for the handling of the film in the darkroom. Suggestions are made for the elimination of undesirable markings and for the establishment of procedures that will result in clearer and more useful radiographs. Among these are correct design and equipment of the darkroom, proper ventilation, adequate drying facilities, cleanliness, and careful procedure. Where large amounts of X-ray inspection take place, automatic developing machines are recommended. *Aero Digest*, August 1, 1944, pages 77, 122, 5 illus.

Instruments

Control Tower Instruments. Part I. R. C. Blatt. Part I of a continued article on control-tower instruments and their maintenance discusses wind direction equipment. Sections deal with the checking of the transmitter support, transmitter lubrication, the care of the mercury seal, cleaning the upper spindle bearing, and the disassembly of the transmitter and indicator. Other sections discuss indicators, motor lubrication, cleaning the motor brushes, and checking indicators with a wind vane. *Aviation Maintenance*, August, 1944, pages 58, 158, 162, 166, 168, 170, 172, 6 illus.

Precision Repair Work. Exemplified by the operations of Roydes & Edwards Ltd., this article tells of the precision work involved in the repair of aircraft instruments. It is concerned chiefly with the repair of "capillary-type" instruments for the R.C.A.F., which is the main activity of the firm at present. In addition to relating how damaged instruments are restored to maximum efficiency, the article describes the materials, functions, operation, filling medium, and metals of the capillary instruments. *Canadian Aviation*, August, 1944, pages 127, 128, 130, 6 illus.

La Radiotélémétrie, Nouveau Procédé de Guidage des Avions? (Is Radio-Telemetry To Be a New Position-Fixing Method for Airplanes?). Gérard de Chambrier. A description is given of an instrument and method known as radio-telemetry, the invention of two Swiss scientists. It is used at present at the aerological station in Payerne, Switzerland, to determine instantaneously the exact position of radiosondes. From a single station on the ground, the distance which separates a radiosonde from the station may be measured. To check the accuracy of this method, it was decided to test it aboard a glider.

The operation of the method is as follows: A radio transmitter on the ground sends a modulated wave of a given length to the glider, from which it is retransmitted to the ground on a different wave length by means of a receiver-transmitter called a telesonde. The interference of the two waves is indicated on the ground by an oscilloscope and gives the distance, which may be read directly from a quadrant whose graduation is in kilometers. The azimuth is given by means of a directional receiving dipole. Another radio set is installed in the glider for communication with the ground.

The tests lasted for several weeks, first with the glider in independent flight and then when towed by an airplane. The results are reported to have been excellent. Although the inventors state that considerable work

"So solly please, still got more licking to take!"

"The war isn't over" at Langley . . . . we have facilities to assist you in producing precision items of war necessity. Perhaps the co-operation of Langley management, skilled craftsmanship and specialized precision equipment is just what you're looking for. *Wire or phone for information.*

POST WAR..

A market of 4¼ million "ain't hay"!

Most of these four and a quarter million people live within a hundred and twenty-five miles of San Diego, where climate is easier and workers like to live. If your postwar plans include a manufacturing outlet on the Pacific Coast, we invite discussion.

LANGLEY PRECISION Manufacturers
CORPORATION
SAN DIEGO 1, CALIFORNIA

Get out and get un-der-

● Today, we can laugh at the old song—but there was a time when *"Get out and get under"* was no joke.

That was before great improvements in engineering, manufacturing methods, and materials had made the motor vehicle a near-miracle of dependability.

And it was before the development of standardized, precision-built parts had made a further important contribution to the *quantity* production of *quality* cars. Eaton men worked closely with automotive engineers and production specialists throughout this development period, designing and building many a vital part for a long procession of constantly newer and better motor cars.

For two and a half years, Eaton, of course, has been 100% engaged in war work. Like others, we have learned many new skills and new secrets under the tremendous pressure of war demand. We have found better methods and reached new standards of precision.

What we have learned in building for war should enable the Eaton organization to play a more helpful part than ever before in the development of peacetime automotive future. When the time comes, Eaton will be ready.

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General Offices: Cleveland, Ohio
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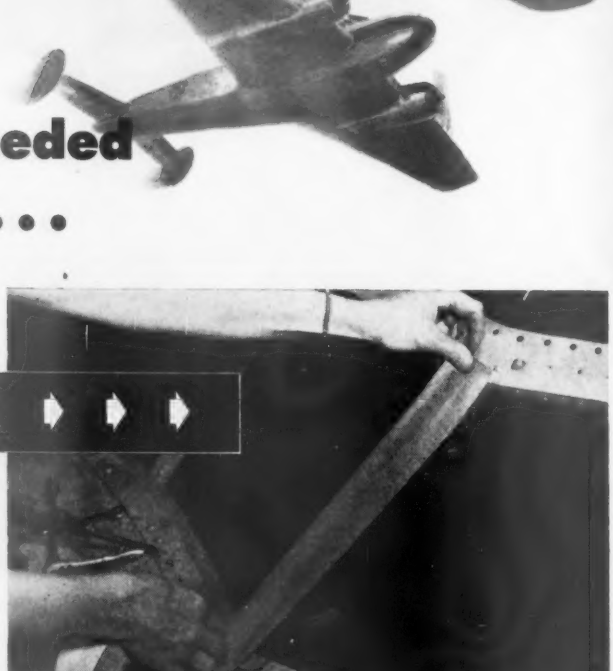
SUPPLIERS OF FINE PRECISION PARTS TO THE AUTOMOTIVE AND AIRCRAFT INDUSTRIES FOR MORE THAN THIRTY YEARS —NOW, AND TILL VICTORY IS WON, DEVOTING OUR ENTIRE FACILITIES AND RESOURCES TO WAR WORK.

NOW—

no oxygen mask needed at extreme heights . . .

thanks to FABSEAL



AMONG the many recent advances in aircraft construction is the pressurized cabin. This enables crewmen to work without oxygen masks even at extremely high altitudes.

Pressurizing aircraft cabins involves sealing every seam, window and door against leaks. To accomplish this purpose, many miles of Pittsburgh Fabseal tape are now being used in the construction of American fighting planes.

The fabric of Fabseal tape is impregnated with sealing compound. Before impregnation this fabric is treated to make it water-, gasoline-, and oil-resistant and to prevent wicking action. Fabseal remains flexible in temperatures far below zero.

Fabseal was developed by the Paint Division of the Pittsburgh Plate Glass Company, which also supplies vast quantities of aircraft finishes for all types of planes. Our long experience in this field can frequently save you time and money.

Easy to apply. Fabseal is easy to handle and can be applied to any metal and wooden section of a plane. It comes in rolls with an inter-leaf separating the fabric layers. After application, the inter-leaf is removed exposing the tape's upper surface which is then ready to receive another member for riveting.

PITTSBURGH PLATE GLASS COMPANY, Industrial Paint Division, Pittsburgh, Pa. Factories: Milwaukee, Wis.; Newark, N. J.; Houston, Texas; Los Angeles, Calif.; Portland, Ore. Ditzler Color Division, Detroit, Mich. The Thresher Varnish Co., Dayton, O.

PITTSBURGH *Industrial* **FINISHES**

PITTSBURGH STANDS FOR QUALITY PAINT AND GLASS

remains to be done to make this method applicable to airplanes, they believe that all obstacles may be overcome in time. *Schweizer Aero-Revue*, April, 1944, pages 127–128.

What's Your Groundspeed? Warren C. Youngclaus. A description is given of a simple drift-sight attachment developed by the writer. It consists of a gravity-actuated index arm pivoted so that the arm always indicates the vertical regardless of the position of the sighting tube of the drift sight. A graduated arc attached to the sighting tube indicates the angle of the eyepiece from the vertical. Two methods for determining the groundspeed with this attachment are described. *Air Transport*, August, 1944, pages 79, 80, 4 illus.

Landing Gear

Aircraft Suspension Systems. F. E. Burger. Noting some of the differences between articulated and telescoping-tube types of aircraft-undercarriage legs, the writer indicates the advantages offered by the telescopic cantilever leg. He also describes a new compensating bearing, which it is claimed will correct the "sticking" difficulty likely to be encountered in cantilever oleo legs when a plain bearing is used. The prediction is made that, if American methods of airport construction are adopted, the trend of undercarriage design will probably lean toward the reinstatement of a simple kind of sliding-tube cantilevered undercarriage, especially if the disadvantage of binding of the sliding member under braking loads can be eliminated successfully. Comments are made about the relative weights of the two systems. *Flight*, July 27, 1944, pages 99, 100, 2 illus.

Lubrication

Lubrication of Martin Planes. I. T. Turner. It is noted that the lubrication of aircraft is not so simple a procedure as might be desired because of the number of different types of mechanism used. AN specifications for ten lubricants most frequently used are listed. Information is furnished regarding the temperature range for aircraft lubricants, the development of special aircraft lubricants to keep pace with operational requirements, the incorporation of suitable facilities for servicing airplanes after they have left the factory, and postwar requirements for lubricants. Charts are given showing lubrication points for the Martin Mariner, Marauder, and Baltimore. *Air Tech*, September, 1944, pages 31, 32, 58, 3 illus.

Maintenance

Overhauling the Eisemann Magneto Used on Small Planes. A brief outline of how to service the Eisemann Model AM magneto, which is employed on light planes. The writer tells how to disassemble the magneto, replace and adjust parts, and reassemble it. Special tools required for the work are mentioned. *Aviation Service Magazine*, July-August, 1944, pages 24–28, 56, 14 illus.

Servicing Exhaust Manifolds. Robert Chase. The maintenance and repair of both the slip-joint and ball-and-socket types of exhaust collectors are discussed. Because the majority of exhaust systems are made of stainless steel, the writer assumes the use of this material in the processes described. Problems of the slip-joint collector discussed include cracks in the collector body or port legs, wear at the section joints, the repair of damage caused by "hot spots," and periodic inspection and overhaul. It is noted that service problems in the ball-and-socket type of collector are different from those encountered with the slip-joint collector because the former is mounted on the engine mount or cowl well through a series of links. The installation, inspection, and maintenance of ball-and-socket collector system are discussed in some detail. *Aviation Maintenance*, August, 1944, pages 56, 57, 116, 118, 120, 122, 124, 126, 8 illus.

Synthetic Rubber Minimizes Aircraft-Maintenance. John A. Tallant. Describing the characteristics of synthetic rubber, this article indicates applications in aircraft maintenance where it can be used to advantage. The following are noted among the potential airplane-maintenance uses for synthetic rubber: for resilient parts in power plants; for instrument mounts and other vibration-damping equipment; for brake linings; for ignition-cable jackets; and for upholstery, floor coverings, mats, door strips, etc. A comparison between the qualities of synthetic and natural rubber further shows the possibilities of the former for maintenance purposes. *Air Pilot and Technician*, August, 1944, pages 27, 28, 2 illus.; "Why Synthetic Rubber Minimizes Aircraft Maintenance," by John A. Tallant, *Air Tech*, September, 1944, page 50.

Spare Parts Control. Fowler Barker. A description of Pratt & Whitney Aircraft Division's experience with systems for assuring spare parts in the right quantities evolved by Army, Navy, and British plant committees. It is stated that the experience indicates a system the air lines and manufacturers for the air lines could use as a basis for postwar orders. *Air Transport*, August, 1944, pages 40–42, 4 illus.

At Hoosier Airport They Like Problems. This article recounts the methods by which two types of problems were solved at a privately operated Indianapolis airport. One type of problem has to do with airplane storage and hangar space; the other, with the devising of special servicing and maintenance tools when equipment could not be obtained because of priority difficulties. Among the tools described are a hydraulic press made from "junk" materials; a magneto tester fitted onto a lathe; an engine-test stand constructed from the tail of a crashed plane; a jig for bushing of cylinders; a grinder for the top end of the cylinder bore. *Aviation*, August, 1944, pages 170–172, 259, 260, 9 illus.

The Douglas C47 Skytrain. The Workhorse of the A.A.F. Gerard E. Nistal. Information regarding the constructional design of the Douglas C-47 Skytrain is presented with particular emphasis on maintenance considerations. In addition to illustrations of the general assembly and fuselage breakdown, there are charts of the hydraulic system, fuel system and pilot's instrument panel. Details are furnished about the power plants, heating and ventilating system, and other equipment. *Air Tech*, September, 1944, pages 16–22, 57, 13 illus.

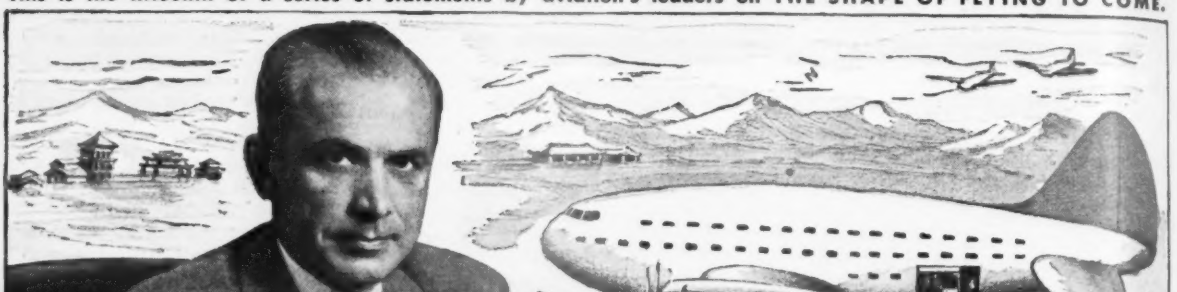
Centralized Control vs. Duplication. E. J. Foley. The subject of air-line maintenance in the postwar period is discussed. The various aspects of both decentralized and centralized maintenance are examined. Following a brief analysis of the situation, the writer finds that scheduling and routing at the home base offers many advantages. *American Aviation*, August, 15, 1944, pages 74, 78, 1 illus.

"Cannonball" Service. Robert D. Charles. An account of how Pan American Airways, under contract with the U.S. Army Air Forces Air Transport Command, is operating and servicing ATC planes on the "Cannonball" route between Miami, Fla., and Karachi, India. Information is given about periodic services for planes and engines, accessory-overhaul periods, instrument-overhaul periods, and testing procedure for aircraft and engines. *Aviation Maintenance*, August, 1944, pages 39–45, 178, 180, 6 illus.

How to Look After Those Aerols. Edward E. Thorp. Methods for the proper servicing of Aerol struts are advised. As a basis for the comprehension of the discussed methods, the construction and operation of various cantilever and compression type Aerol struts are explained. Explanation of the means by which these devices absorb landing shocks is followed by details about the procedures to be used in installing, inspecting, maintaining, removing, storaging, assembling, and disassembling Aerols. Specific suggestions are made regarding the routines of daily, 25-hour, and 100-hour checks. *Aviation*, August, 1944, pages 167–169, 247, 248, 8 illus.

Kits Make Engine Buildup Simple as A B C. Herbert P. Jewell, Jr. A description of how time studies carried out by Consairway have contributed to the economic operation of this air line. It is explained that results include the fluid shifting of mechanics from regular jobs to emergencies, the time saved in requisition-

This is the fifteenth of a series of statements by aviation's leaders on THE SHAPE OF FLYING TO COME.



"Air Transport will map new frontiers for Business"

says T. CLAUDE RYAN, President of The Ryan Aeronautical Company.

"I BELIEVE *that a first-rate, world-wide air transport system is vital to American prosperity after the war.*

"If American businessmen can make many of their deliveries by air, especially to remote regions —and get there faster than foreign competition— then we shall sell millions *of new customers.*

"For instance, rival manufacturers in Moscow and Chicago may learn of lucrative business to be picked up in China; the Russian is going to have a big advantage if he can hop a plane that gives him a 24-hour head start on his competitor.

"Today, thanks to the exigencies of war, we have the finest air transport system. After the war, we'll have to guard that supremacy, or others will skim the cream of world trade. So let us maintain a web of powerful, high-speed American airlines that will radiate from American factories and deliver American products almost overnight to countries thousands of miles away.

"Thus we shall keep industry humming, more and more jobs will open up, and America will prosper."

• • •

YES, MR. RYAN, America can do it. But American passenger and cargo planes will dominate world skyways only when the projects of the aviation industry have been sold as down-to-earth practicalities—sold to that "test pilot" market of U. S. men who are ready to buy progress whenever they see it either in business or in private living.

This is the market aviation thinks of when it thinks of the more than a million TIME-reading families—who are America's best prospects for planes and air travel—whose positions in American business make them the natural national vanguard for any programs aviation may set up—who vote TIME their favorite magazine 7 to 1 over the runner-up.

Believing that the ideas of aviation's leaders are always of interest to the aviation industry, TIME here gives them wider circulation in the name of

AVIATION'S SILENT PARTNERS

TIME

THE READERS OF TIME

ing material at the stockroom by having much material available on the job, and complete engine-repair kits of parts within reaching distance of an engine overhaul.

The buildup kit, of which there are two types for two different transports, delivers to mechanics every part needed in a build-up operation. This eliminates wasteful trips to the stockroom by crew members. The kits themselves are movable racks on which parts are carried in separate bins. These are numbered according to sequence of use, a fact that speeds mechanics' selection of each part needed. Kit numbering corresponds with bin numbers in the stockroom so that a kit may be assembled quickly in advance of need and later rolled to the point of use when needed. *Air Transport*, August, 1944, pages 32–37, 10 illus.

Importance of Salvage. Capt. C. W. Fox. The importance that the Navy places on aircraft salvage operations is emphasized. It is explained that this is because supply lines are long and the quantities of materials moved to war theaters must be utilized to the fullest extent. On damaged aircraft there are instruments, parts, and materials that can be used on other planes on the spot. The article is continued in the form of a set of questions and answers on repair and salvage operations. *Aviation Maintenance*, August, 1944, pages 67, 68, 174, 176, 178, 10 illus.

Hot-Doping Problems Solved by New Plastic. R. H. Natwick. Some notes on the hot-doping techniques used by Pan American Airways for finishing fabric surfaces. Featured in the described procedures is the use of a special hose, made of a vinyl resin known as Resitoflex compar, for spraying the hot dope onto the fabric. This flexible hose is said to be wear-resistant, solventproof, impervious to the chemical action of hot collodial dope, and immune to temperature extremes within a range of −70° to +300°F. Savings in maintenance time are reported as a result of the discussed techniques. *Aviation*, August, 1944, pages 178, 265, 266, 2 illus.

Overhaul Assembly Line Trains Specialists Quickly. William Maxfield. A straight method of electrical and radio overhaul, which permits mechanics to learn a few operations quickly, is described. The method was adopted by TWA to offset the man-power shortage. An assembly-line system, with mechanics specializing in certain operations instead of performing a variety of duties, is employed throughout the maintenance department. *Air Transport*, August, 1944, pages 55, 56, 59, 60, 10 illus.

Building an All-Wood Wing for a Light Airplane. M. F. Foose. A detailed description is given of how to replace a wing of a light airplane. It is assumed that the original wing is so thoroughly damaged that it cannot be used as a pattern. Information is furnished about obtaining the dimensions for the spars, duplicating the plywood reinforcing plates, laying out the holes for the various fittings, installing the compression member, and assembling the ribs on the spars. *Aviation Service Magazine*, July–August, 1944, pages 14–22, 34, 27 illus.

Hi, Fellah! Joe Chase. Advice is given about correct and efficient methods of changing spark plugs during a periodic engine check. The routine of removing the old spark plug and installing the new one is traced step by step. *Air Facts*, September, 1944, pages 62, 64, 66.

Management

Cost Control. J. P. Wilson. Recommedations are made for the application of cost standards to aircraft accounting. Investigating the "component" and "direct analysis" methods of costing, the writer explains the principles, advantages, and disadvantages of each. After a comparison of the two methods, he concludes that the component method is more sound and that the problems of air-frame costs can be solved by the adoption of this method if the major difficulties of delay, caused by having to cost one stage of manufacture before another, and clerical volume, can be overcome. He states that these difficulties can be overcome by (1) the reorganization of the administrative functions to combine cost accounting with the material-control and production-control functions in a control department, using common records, and (2) the adoption of standard costs, utilizing the physical and performance standards already in use for other purposes.

The writer justifies his recommendations and outlines two plans of standard costs. Under the first plan a work-in-progress account is set up for each department. This account is charged with the actual cost of all work done in the accounting period of 1 month and credited with the actual cost of all the orders completed during the month. The balance remaining on the account then represents the value of work-in-progress at actual cost. Under the second plan a departmental operating account is established for each department and one work-in-progress account for the whole plant. *Aircraft Production*, August, 1944, pages 397–401, 4 illus.

Incentive Pay in Aviation. Philips J. Peck. Advantages of and objections to wage-incentive plans in the aviation industry are examined. Although it is claimed that incentive pay results in greater quantity of production, lower unit costs, and better utilization of man power, and that its general adoption by the aviation industry could have caused the production of 30,000 additional planes in 1943, the report is that, for the most part, the idea has been rejected by airplane companies. Reasons for both management and labor opposition are given. However, it is demonstrated that, in spite of this, several companies have adopted wage-incentive plans and have operated them successfully to the benefit of the war effort, the company, and the employees. Among these companies are mentioned Grumman Aircraft Engineering Corporation, Beech Aircraft Corporation, Republic Aviation Corporation, Chance-Vought Aircraft Division of United Aircraft Corporation, Firestone Tire & Rubber Company's Aviation Production Division, Edo Aircraft Corporation, and Pratt & Whitney Aircraft Division of United Aircraft Corporation.

The article also outlines and explains the three broad classifications under which incentive-pay plans can usually be grouped: individual award, departmental awards, and plant-wide incentives. *Flying*, September, 1944, pages 60, 122, 124, 2 illus.

Marketing

Public Relations for the Operator. William D. Strohmeier. The importance of a constructive public relations program to airport and flying-service operators is demonstrated and suggestions are offered on how such a program should be conducted. Five basic phases of public relations for the operator are discussed: appearance of building, grounds, and airport; various forms of service, such as line service; definite parking-line procedure, speedy and efficient gasoline service, catering to nonflying visitors, etc.; appearance and attitude of personnel; advertising; and publicity. Principles of planning a definite schedule of advertising and of setting up a publicity-directing system are outlined. *Air Facts*, September, 1944, pages 11–18, 1 illus.

Where are Those Marketing Plans? John H. Frederick. In evidence of the contention that private-plane manufacturers are not yet ready with postwar marketing plans, the writer demonstrates the difficulties of potential distributors in obtaining substantial information from the manufacturers with which to formulate their own plans. He relates the case of one meritorious distributor who submitted the following questions to private-plane manufacturers and received either negative answers or ones that revealed an apparent lack of postwar planning: (1) What minimum capital outlay will you deem necessary for a sales and service organization serving the various-sized territories you contemplate setting up? (2) Do you propose to grant exclusive agencies? If so, under what conditions? (3) How many different models of private aircraft do you propose to place on the market during the immediate postwar years? What is the proposed price of each model? (4) What commission will be offered dealers? (5) What are your plans for sales help and promotion to aid dealers?

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The writer follows this incident with a summary of the technical and psychological problems with which the postwar personal-plane market will be faced. He stresses the need for the institution of a widely planned, vigorously executed campaign on the part of the manufacturers to meet these problems. *Aviation*, August, 1944, pages 121, 267–270, 1 illus.

The Man with the Warehouse Mind. Wesley Price. This is an account of a remunerative business established by an airplane-parts dealer. It tells the story of Bob Meltz who buys obsolete and "cracked up" planes to sell the salvaged components. *The Saturday Evening Post*, August 19, 1944, pages 22, 23, 81, 4 illus.

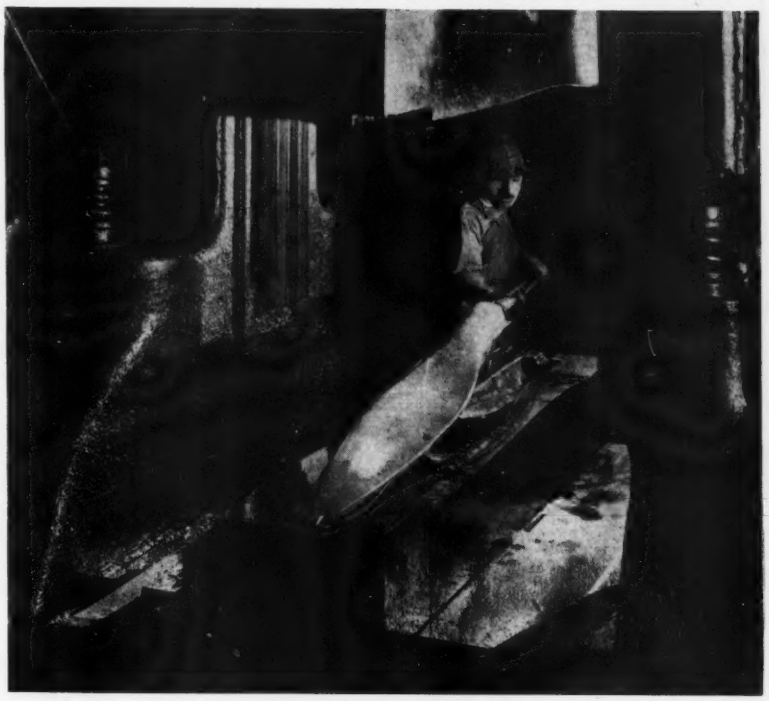
Materials

New Silicone Fluids. Franklin M. Reck. A series of notes contains information about the characteristics of silicone products and the methods employed by the Dow Corning Corporation for producing them. The data are pertinent to silicone fluids suitable for damping aircraft instruments, silicone resins which permit the operation of motors and generators at high temperatures, and silicone greases for high- and low-temperature use.

Two types of fluids in production at Dow Corning are discussed: One is the "200" type, of relatively high viscosity ranging from 100 to 1,000 centistokes. The resins include the number 993, a heat- and moisture-resistant varnish for impregnating nonrotating coils and varnishing Fiberglas, and the number 2052, a thermosetting varnish for rotating equipment. Specific commercial applications of the silicone products are named. The Grignard reaction process, which has been adapted for the silicone-manufacturing procedures, is mentioned. *Aero Digest*, August 15, 1944, pages 106, 138, 1 illus.

Corrosion Testing of Water-Soluble Aluminum Cleaners. Jay C. Harris. Reference is made to new corrosion-testing problems arising because of the availability of new alloys, changes in chemical technology, the production of new chemicals, and the present need for finding substitute materials. It is noted that there is no standardized procedure for the corrosion testing of aluminum. An outline is furnished of the essential characteristics of a number of corrosion tests that have been published. Included are corrosion tests defined by Government specifications for aircraft and aircraft engines. *ASTM Bulletin*, August, 1944, pages 21–29.

Aluminum Still Main Plane Material Despite Products of War Research. Prospects for aircraft materials in the postwar period are discussed. Reasons are given for the belief that aluminum will continue to be the main airplane material. It is stated, however, that magnesium, steel, wood, and plastics are expected to find wide use in the aircraft industry, with the trend toward the utilization of all types in single units where each has physical and economical advantages. *Aviation News*, August 21, 1944, pages 13, 14.



Photograph Courtesy Aluminum Company of America
Forging an aluminum propeller blade.

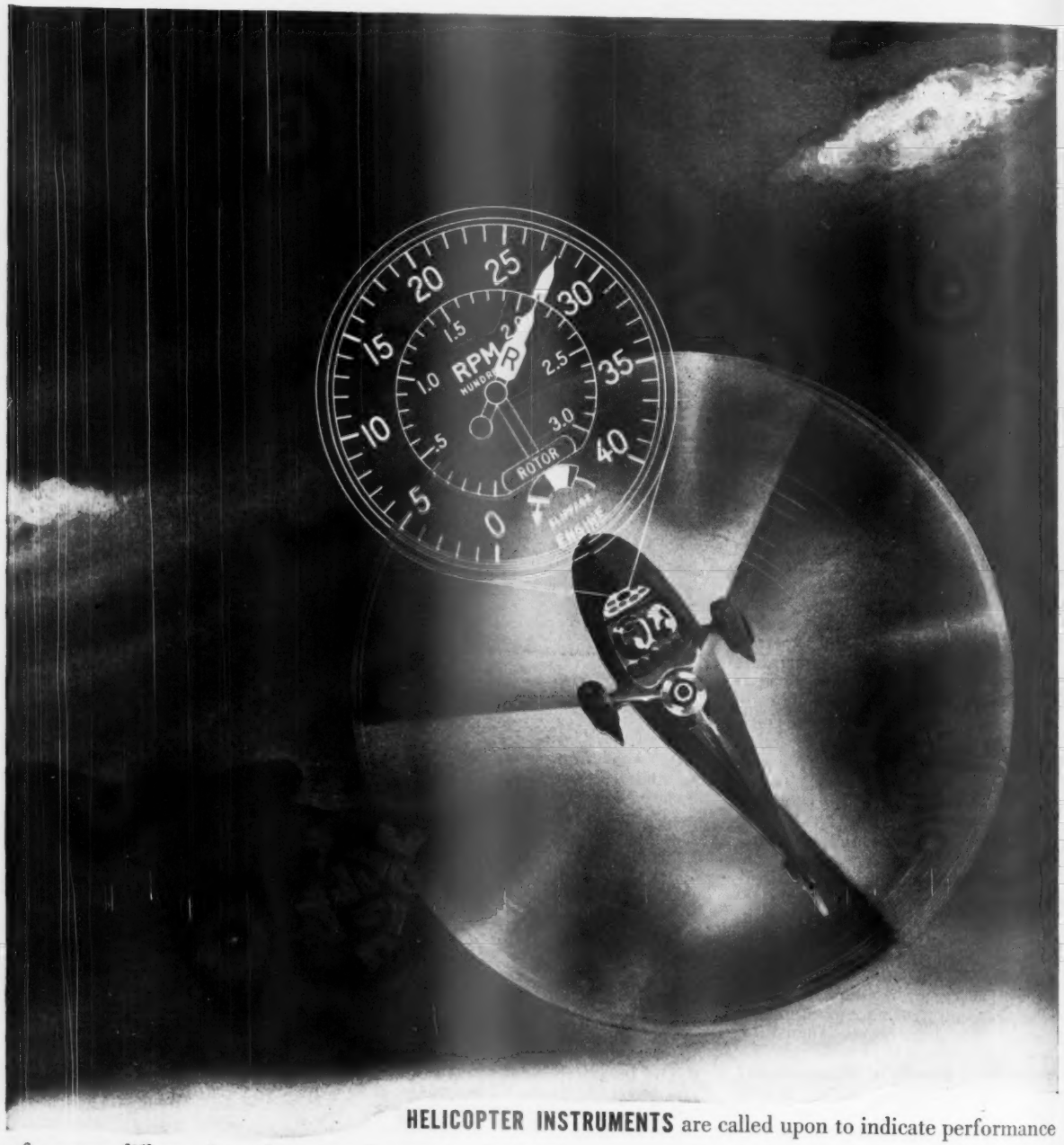
Medicine

Some Observations on the Validity of the Schneider Test. Craig Taylor and Guy E. Brown, Jr. The writers review some of the literature on the use of the Schneider Index to detect the effects of fatigue, physical fitness, minor infections and convalescence, and psychoneurosis. The results of 325 Schneider tests on healthy young men, aged 18 to 28, are presented statistically in support of certain conclusions concerning the reliability and validity of the Index in rating the cardiovascular fitness of normal individuals. *The Journal of Aviation Medicine*, August, 1944, pages 214–230, 2 illus.

Neuropsychiatric Aspects of the Civilian Pilot Examination. Whitman C. McConnell and Whitman H. McConnell. The making and recording of neurologic and psychiatric findings in examining pilots is discussed. Information is furnished about the examination of the optic and other cranial nerves. Reference is made to the complex psychiatric terminology which is stated to be a stumbling block in the study of abnormal reactions to stimuli, and to the trend toward simplification. Four classes of mental states are discussed. These include (1) normal, (2) feebleminded, (3) psychoneurotic, and (4) psychotic. It is noted that the victim of any mental disease should not fly. *The Journal of Aviation Medicine*, August, 1944, pages 231–237.

The Importance of Human Sizing Standards in Aviation. Lt. Albert Damon, Lt. Francis E. Randall, Lt. Robert S. Benton, and Alice M. Brues. A paper discussing the application of human sizing standards to military aviation. The methods used and the results obtained are described. The article deals particularly with the work of relating the physique of Army Air Forces fliers to the design of flying equipment, which is being carried out at the Aero Medical Laboratory at Wright Field with the aim of increasing the comfort, efficiency, range of vision, and safety of fliers. *The Journal of Aviation Medicine*, August, 1944, pages 238–243, 4 illus.

The Effect of Nasal Ventilation Upon Tubal Equalizing Efficiency in Flying Personnel. Lt. Comdr. H. J. Sternstein and Lt. Comdr. J. B. McGregor. This paper describes an investigation conducted with a new method for determining the quantitative effects of nasal resistance on the functional dynamics of the eustachian tube before and after the use of a nasal shrinking agent. The study was undertaken to determine the amount of pressure necessary to ventilate the middle ears of those individuals susceptible to aero-otitis media as a basis of selection for flying personnel. The results of the investigations are summarized and recommendations are



HELICOPTER INSTRUMENTS are called upon to indicate performance of a nature different from that generally associated with the operation of conventional airplanes. Kollsman has already devised a special dual tachometer and synchroscope for experimental helicopter work. A super-sensitive air speed indicator is also called for, because of the helicopter's ability to move at low lateral speeds. The ship's ability to hover and to make slow descents also suggests refinements in rate-of-climb indicators. Whatever the ultimate instrument requirements of the helicopter, Kollsman engineers will be ready with practical and efficient designs, keeping pace, as always, with every advancement in the science and the art of operation.

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made with regard to further study. *The Journal of Aviation Medicine*, August, 1944, pages 244–257, 12 illus.

The Role of the Extra-Ocular Musculature in the Aviation Physical Examination. A. J. Herbolsheimer. Fundamental principles involved in the measurement of the functions of the several extra-ocular muscles are elucidated. Consideration is then given to factors that confuse results and produce inconsistencies in reported findings. It is noted that, since the examiner cannot experience another's sensations, tests for extra-ocular muscle function are subjective. That is, the applicant must be relied on for information. Suggested limitations to these subjective tests are faulty equipment, confusion or lack of understanding on the part of the applicant, and willful deception by the applicant. Each of these three categories is discussed. An instrument developed to aid the examiner in detecting willful deception of the applicant is described and illustrated. *The Journal of Aviation Medicine*, August, 1944, pages 258–263, 1 illus.

Preliminary Survey on the Color-Vision Plates of Shinobu Ishihara. Major G. S. Backenstoe. It is stated that color-vision analysis is a subject offering opportunities for study and research. As a start on color-vision research, an analysis of the Ishihara plates on 52 to 58 cases was conducted. Measurements of neutral bands on standard 8-in. spectrums were charted. The analysis resulted in the discovery of unexpected variations from Ishihara's statements. *The Journal of Aviation Medicine*, August, 1944, pages 272–278.

An Unusual Type of Aircraft Accident. Major Ivor M. Campbell. As an example of the hazards of flying in "thunderheads," the case of a pilot injured by hail stones when his plane was disabled and he was forced to descend in a parachute is described. This pilot was able to return to flying duties within 48 hours after medical treatment. *The Journal of Aviation Medicine*, August, 1944, pages 279, 280, 1 illus.

Metallurgy

A Numerical Rating Method for the Routine Metallographic Examination o : Commercial Magnesium Alloys. P F. George. This article describes a method for the routine examination of magnesium alloys developed to enable inexperienced persons to record the microstructure. Sections describe the specimen preparation, etching technique, and a rating system for recording the microstructure as a series of numbers. *ASTM Bulletin*, August, 1944, pages 35–44, 13 illus.

Meteorology

Hot Air. Wolfgang Langewiesche. First part of a series on the idea that weather is caused by updrafts. This installment is devoted to explanations of the nature and action of updrafts, the differences between vertical and horizontal air currents, and conditions under which an updraft may be expected. In considering the latter point, one factor of primary importance to the pilot is discussed at length in this installment while examination of other factors will follow in subsequent installments. The discussed factor is the temperature difference between the ground and the air that lies upon it. *Air Facts*, September, 1944, pages 46–52, 54, 56, 57, 3 illus.

Photograph Courtesy A.A.F. Air Technical Service Command

A B-25 medium bomber, experimentally equipped with rockets to shorten the run, taking off at Wright Field. Assisted take-off experiments have been in progress at Wright Field since 1940.

Military Aviation

Mass Tactics in Aerial Battle. By A. F. In this article the writer discusses fighter formations and the future aspects of aerial fighting. Elementary fire problems are described and illustrated with diagrams. Various tactical maneuvers are reviewed. *Aeronautics*, August, 1944, pages 50–53, 4 illus.

Naval Aviation

Carriers Come of Age. Alice Rogers Hager. Supplemented by an indication of the value of the aircraft carrier to present-day naval combat, this is a history of carrier-based aviation from 1909 to 1944. Refinements in carrier construction, equipment, and application techniques are traced, as are improvements in maneuverability, armament, and handling of planes. *Skyways*, September, 1944, pages 38, 39, 53, 54, 58, 64, 36 illus.

The Development of Naval Fighter Aircraft. A student of naval aircraft reviews British shipborne fighter development and summarizes recent progress. A table gives details and performance figures of shipborne fighter aircraft from 1916 to the present. *Aeronautics*, August, 1944, pages 36–39.

Passing of a Famous Biplane. Because of the expected termination of Fairey Swordfish production, a case history is presented of this British biplane. The review refers to both the production record and the performance record of the aircraft. There are notes on the "Group" system by which the Swordfish was manufactured as well as on the combat feats of torpedo-bombing, depth-charge attack, and reconnaissance which have marked its career during this war. *Flight*, July 6, 1944, pages 12a, 12b, 13, 7 illus; "Ten Years of Service," *The Aeroplane*, July 7, 1944, page 16, 4 illus.; "Fairey Swordfish," *Aircraft Production*, August, 1944, page 402, 1 illus.

Carrier Types . . . Of World War II. Some facts are given briefly on seven types of United States aircraft carriers used in World War II. The first three are of the "U.S.S. Ranger," "U.S.S. Enterprise," and "U.S.S. Saratoga" types; the fourth is the CVE escort-class carrier; the fifth, the CV classification; the sixth, the CVL model; and the seventh, the CVB type. All classes of carriers except the last are illustrated by photographs of representative ships. *Skyways*, September, 1944, pages 44, 45, 5 illus.

Paints and Coatings

Plating Practices of the Aircraft Industry. Procedures for zinc and cadmium plating are described in an article based on a survey of aircraft practice made by Lockheed Aircraft Corporation. The writer discusses precleaning, pickling, the actual plating operations, and passivation. *The Iron Age*, August 10, 1944, pages 56, 57.

Protective Coatings for Aircraft Parts. Steps generally employed to impart corrosion resistance to aircraft components are outlined in this arti-

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(Top) National Airlines' ("The Buccaneer Route") Lockheed Lodestar aloft over Miami, Fla.

(Bottom) American Airlines' Flagship (Douglas DC-3) serving the Southern Transcontinental Route

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cle, the last in a series based on a survey of aircraft practice made by Lockheed Aircraft Corporation. The writer discusses Parkerizing and Bonderizing to protect iron and steel, and anodizing and chromodizing for the protection of aluminum. *The Iron Age*, August 17, 1944, pages 72, 73, 184.

Stainless Steel and Magnesium Pickling. The second of two articles based on a "Process and Paint" survey conducted by Lockheed Aircraft Corporation under the auspices of the Methods Improvement Panel of the Aircraft War Production Council. Special pickling problems arising from the individual characteristics of stainless steel and magnesium are discussed. A description is given of operational sequences and unit installations. *The Iron Age*, August 3, 1944, pages 59, 138.

Plastic Impregnation of Magnesium Castings. Information is given about a new synthetic resin which is claimed to have advantages over tung oil as a sealer or impregnant for magnesium castings used in aircraft engines. The synthetic resin is designated by the manufacturer as No. 988. It is a 100 per cent nonvolatile compound and has a viscosity of Y–Z on the Gardner-Holdt scale (18–23 poises). The article describes how the impregnating solution is prepared and gives the recommended impregnating procedure for sealing porous castings. *The Iron Age*, August 10, 1944, page 63.

Organic Coating Aids Magnetic Inspection. Gilbert C. Close. A brief description of how Douglas Aircraft Company formulated an organic coating for use in place of cadmium in the magnetic inspection of steel aircraft parts. The purpose of the cadmium flash coat was to provide a bright, lustrous background against which the dark, ferromagnetic particles would stand out sharply.

It is explained that the material now in use consists of a synthetic hi-solids white primer-surfacer (one part) cut by approximately four parts of toluene substitute thinner. This formula produces a white or light background against which the magnetic indications are easily discernible. It is stated that the material is quicker to apply and cheaper than the cadmium flash coating process. *The Iron Age*, August 31, 1944, page 41, 1 illus.

Personalities

"Doc." George R. Reiss. A biographic sketch of Dr. Karl Arnstein, Vice-President in Charge of Engineering of Goodyear Aircraft Corporation. Information is furnished about his engineering contributions to the field of lighter-than-air craft. *Air Trails*, October, 1944, pages 22, 58, 60, 2 illus.

Personnel

Your Postwar Aviation Job (Airlines). N. L. Engelhardt, Jr. First of a series of articles investigating the possibilities of careers in the air-transportation field after the war. In this introductory article a specialist in aviation education discusses the point that postwar jobs in air transportation will depend upon increased demand for air travel and that, in turn, increased demand will depend upon the education of people to the uses they may make of air transportation. Therefore, he outlines certain general ways in which an aspirant for an air-line career may help to promote a job for himself and others by arousing people's interest in traveling and shipping by air. The article is supplemented by a table showing the relative importance of each department of an air line in terms of the number of jobs available for each 1,000 persons employed. *Flying Aces*, September, 1944, pages 22, 23, 64, 7 illus.

Plastics and Plywood

Low-Pressure Laminating. W. Nichols. Describing the technique of low-pressure laminating, the writer explains how it differs from the high-pressure method and outlines the advantages of low-pressure molding. These include the greater economy in time and cost, the smaller capital investment in machinery, the wider flexibility of the system so that design changes can be easily made, and the fact that the equipment is more readily available. The pressure-actuating systems and the types of molds used are listed as (1) the hot-press type, (2) a modification of the hot-press type using cast and welded molds, (3) chase and force plugs made of combinations of wood, metal, and other materials, and (4) the autoclave method. Resins employed are described and their specifications are tabulated.

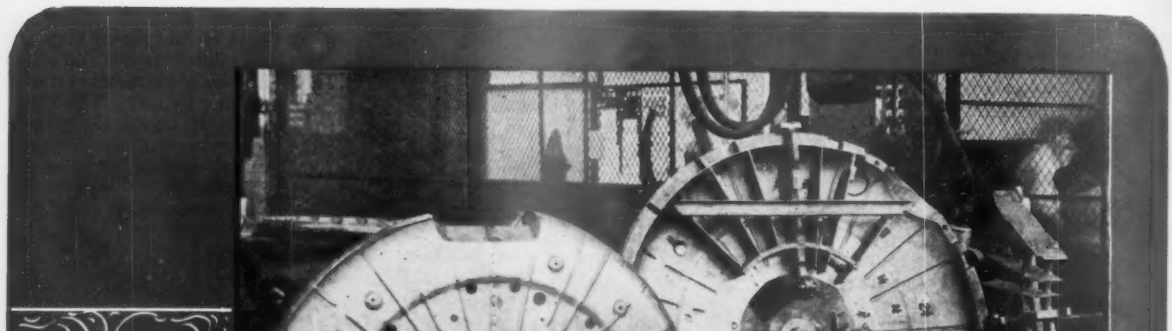
The process is explained in detail, with comments about the factors that will affect the results, about the properties of the finished material, and the relationship of the strength characteristics to the resin used. The no-pressure process is also described in connection with its applicability to the making of nonstructural parts. The physical properties of fabric laminates prepared without heat or pressure are discussed and tabulated. It is concluded that with such a range of materials for wartime production, low-pressure laminated parts may make an important addition to the postwar reconstruction program, not only for the aircraft industry, but for other engineering work in industrial and allied fields where lightweight, noncorrosive units, economically produced, can be employed to advantage. *Aircraft Production*, August, 1944, pages 385–388, 8 illus.

Plastics and Metals—Competitors or Collaborators? G. K. Scribner. An analysis of the "competitive" relationship between plastics and metals in the field of products design. The article is of a general nature, but includes information that should be of interest to the aircraft industry. Included are tables comparing the weights of metals and plastics and the strength-weight properties of metals and plastics. Reference is made to the use of plywoods in the Mosquito bomber, and aircraft parts fabricated from laminated plastics are illustrated. *Metals and Alloys*, August, 1944, pages 336–341, 4 illus.

Plastics vs. Metals—A Production Cost Analysis. W. I. Beach. Information is given to aid the engineer in deciding between metals and plastics for certain aircraft parts. For purposes of comparison, a parallel is drawn between injection-molding and die-casting, compression-molding and sand-casting, transfer-molding and permanent-mold casting, and, finally, between metal and plastic forming. The question of the relative cost of making parts from plastics and metals is discussed. A cost analysis of plastic and metal counterparts is given in tabular form. Illustrations include a 0.50-cal. ammunition roller made of plastics, a plastic trim-tab cable drum, and fuel-cell flanges made of plastics and aluminum. *Industrial Aviation*, August, 1944, pages 30–33, 35, 70, 6 illus.

Fatigue Tests on Compressed and Impregnated Laminated Wood. Albert G. H. Dietz and Henry Grinsfelder. This paper presents the results of a series of tests undertaken to determine the endurance characteristics and fatigue limits of compressed and impregnated laminated wood. The article deals with cross-banded and laminated board used for aircraft propellers and other purposes where vibrating loads and stress are involved. The results of the tests are summarized and the conclusions drawn are enumerated. *ASTM Bulletin*, August, 1944, pages 31–34, 6 illus.

Hot Forming of Phenolic Laminates. H. C. Guhl. Reference is made to the rapidly increasing demand for formed phenolic laminates for aircraft. It is stated that this is because of (1) the broadening of available material supplies to meet the stress of war production, (2) the relatively good strength-weight ratio of phenolic laminates, (3) the flexibility in design that is permitted when low cost and easily constructed tools are available, and (4) the convenience of stocking standard sheet materials at the point of aircraft manufacture, which may be readily converted into parts. Typical applications of hot formed phenolic laminates for aircraft parts are illustrated. Newly developed formable phenolic laminates are described and data are furnished



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to guide designers and users in their application. *Plastics and Resins Industry*, August, 1944, pages 7–11, 28, 29, 31, 8 illus.

Plywoods for Present and Post-War Products. Text, tables, and illustrations provide information about plywood and the fabrication of plywood structures. Plywood developments are summarized in sections dealing with veneers, adhesives, manufacturing processes, and joining methods. Illustrations show products assembled from plywood components. The information covers various industries, including aircraft manufacture. Tables show weight and size data for plywood, typical strengths of three-ply plywood, and the characteristics of plywood adhesives. An aircraft-plywood design table and a table showing the strength-weight advantages of plywood also are given. *Product Engineering*, August, 1944, pages 541–556, 52 illus.

Laminated Plastic for Hot Forming. A brief article describes a special laminated plastic that can be formed by inexpensive tools and that is said to retain its properties after forming. Originally developed by Westinghouse Electric & Manufacturing Company for the aircraft industry, this plastic is known as Micarta 444. It has been used for trim-tab fairing, accumulator covers, aviators' chart cases, fuselage tail-wheel housing, wing-gun ammunition feeds and ejection chutes. Information is given about the hot forming, drawing, and shaping of this plastic. The properties of Micarta 444 are listed in a table. *The Iron Age*, August 24, 1944, page 49.

Shatter-Resistant Plastic Glazing. G. M. Kuettel. The development of shatter-resistant plastic glazing for superbombers with pressurized cabins is described. The problem was to produce glazing that would tend to be self-sealing when subjected to enemy gunfire. A laminated safety plastic was developed by using two layers of methyl methacrylate resin with a layer of polyvinyl butyral resin between them. The polyvinyl butyral resin was chosen because of its tough, elastic, impact-resistant qualities. The article tells how special adhesives had to be found to make the product practicable. Laminating technique is discussed, and the material's reaction to gunfire is described and illustrated. It is explained that self-sealing is not accomplished under the severest conditions of low temperature, but the hole formed is of minimum diameter, has a limited fracture area, and may be sealed with a transparent temporary patch. A table gives the properties of the material developed. *Modern Plastics*, August, 1944, pages 85–89, 14 illus.

Strength of New Plastics Compares with that of Metal. John Delmonte. A review of recent developments in the field of plastics. New liquid thermosetting resins that have appeared during the past two years are discussed. It is stated that laminates that have been developed from these resins have made possible materials with strength-weight ratios comparable to aluminum alloys, together with fabrication techniques that permit the development of complicated structures in a single operation. The use of these resins for impregnating cotton or glass fabrics, which are assembled in a suitable form and cured "en masse," is discussed. New liquid thermosetting resins are listed. It is noted that the attractiveness of these new liquid thermosetting resins lies in the fact that they are intended for low-pressure laminating. The curing requirements for these resins are outlined. A table gives the properties of new glass laminates compared with other materials. Aircraft parts laminated with high-strength resins are illustrated. *Machine Design*, August, 1944, pages 119–122, 6 illus.

Load Characteristics of Cellulose Acetate Plastic. Part III. William N. Findley. The concluding part of an article dealing with the load-resisting characteristics of plastics contains a study of the range of stress. It is shown that a cycle of stress may be resolved into two components, a constant or mean value of bending stress and an alternating stress superimposed on the mean stress. The tests imposed upon the material and the equipment used are described in considerable detail, with the aid of charts showing the various results obtained. The conclusions drawn from the tests are summarized in 19 items. *Aviation*, August, 1944, pages 163–165, 260, 263, 264, 8 illus.

Polythene. The nature, properties, and applications of Polythene are reviewed. Originated by Imperial Chemical Industries Ltd., this synthetic thermoplastic is obtained by polymerizing ethylene to a flexible, tough, crystalline solid. In thin sections Polythene may be classified as nonrigid, although it lacks the limp, rubbery quality of most nonrigid plastics. In thick specimens it may be classed among the more rigid plastics. It is said to be flexible and tough under a wide range of temperatures, moisture-resistant, chemically inert, and to have excellent electrical properties. The report also states that this thermoplastic resin can be readily molded and fabricated with existing methods and equipment. *Commercial Aviation*, August, 1944, pages 92, 94, 4 illus.

Postwar Aviation

Warplanes in Peace. Lt. James L. H. Peck. In this article the writer discusses what is to be done with America's thousands of war planes after V-day. It is believed that the first reconstruction requisite will be the rapid dispatching of men and various supplies to many widely scattered strategic localities. The writer discusses how this probably will be done and what planes will be used for the purpose. Consideration is given to communications in the postwar period. It is believed they will follow the military scheme for some time. The sale of aircraft to foreign governments is considered. Reference is made to the possibility of scrapping surplus planes after the war, which, it is stated, might prove most healthy for the aircraft industry. *Air News*, September, 1944, pages 31–33, 12 illus.

Local Air Service Creates New Problems. E. J. Foley. The three factors that dominate the operating phase of local transport are stated to be the pattern of operation, the airport facilities, and the flying equipment to be used. The features of radial, linear, and what the writer terms linear supplementary operating patterns are described. Consideration is given to lessons that may be learned from the pattern of air service used in France. The need for a sound airport development program is discussed. It is stated that realism and proper conservatism should mark every step of this program. Reference is made to the advantages of developing a transport airport pattern whereby two or more closely spaced communities can pool their interests in and desires for air-line service in a common airport. Consideration is given to aircraft design for local service with particular attention to the heating and ventilating system and the luggage accommodations. *American Aviation*, September 1, 1944, pages 76, 78, 1 illus.

The Aircraft Industry After the War. Dean C. Smith. A discussion of the commercial future of aviation after the war. An estimate is made of the number and kinds of air transports that will be needed after the war. Consideration is given to both passenger and freight traffic. Other subjects discussed include the surplus-plane problem, desirable types of postwar transport planes, the use of helicopters in small feeder operations, the loading and unloading of cargo planes, and light planes for civilian use. *The Draftsman*, August, 1944, pages 19, 22, 24, 28, 43, 47, 1 illus.

Latin America's Air Future. Nelson Rockefeller. The co-ordinator of Inter-American Affairs indicates why he believes that a period of great commercial air-transport development is portended for South and Central America after the war. He discusses the particular geological adaptability of those territories for air transport, the commercial conditions that lend impetus to its development, the increase in air lines until this time, and

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the manner in which the war has helped to facilitate commercial air transport in Latin America. *Flying*, September, 1944, pages 48, 49, 148, 152, 154, 158, 3 illus.

Tomorrow Belongs to the Sky. Hector Lazo. The writer draws a favorable picture of the future of airborne commerce. He quotes figures on what air transport has been accomplishing, and cites some actual cases of quick deliveries of goods by cargo planes to meet emergencies. *Air Transportation*, July, 1944, pages 16-18, 1 illus.

The Economic Future of Aviation Technology. Part II. Frederic Flader. Second of a series of articles appraising the value of various aircraft types in the coming peacetime economy. Having established the point in Part I that air-line companies must be enabled to transport air cargo at substantially reduced charges if there is to be any increased volume of traffic after the war, in Part II the writer examines the technical possibilities of airplanes meeting the requirements for lower shipping costs. He analyzes the operating expenses of three different types of aircraft and shows that there is a trend towards a substantial reduction in the ton-mile costs of air-line operation. Because economic trends are projected beyond the transition period that will follow the war, the figures offered are not completely factual but include some estimates.

The three types of aircraft selected for comparison represent (1) a type currently used in civil air-line operation that will continue to be used for some time after the war; (2) a type, developed as a military transport, that will be available for civil use after the war; and (3) a future type of large size, designed primarily as a cargo carrier. A summary of the flying and ground expenses for the three models in the postwar period is shown in tabular form. Another table lists the characteristics of the airplanes. *Aviation*, August, 1944, pages 118-120, 250, 3 illus.

Some Remarks on the Future of the British Aircraft Industry. The progress made by the British aircraft industry during the war is reviewed and the future outlook for the industry is discussed. The writer suggests means of preventing extensive technical development from being thrown away when peace comes. Figures are given on employment and the proportions of skilled female labor in England. *Aeronautics*, August, 1944, pages 28-31, 7 illus.

When the Air Lines Start Again. Group Capt. W. Makowski. This is one of a series of articles disclosing the views of representatives of various European countries with regard to the resumption of commercial air services after the war. In this article the former General Manager of Polski Linje Lotnicze, the Polish air line, defines ideal lines along which air transport should develop. Taking the

HERE'S THE POSTWAR PLANE

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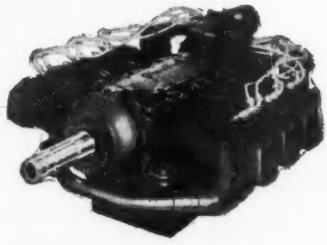
Thousands of aviation-minded men and women responded to our invitation to tell us what they want in their postwar plane. Here's their answer.

...and the engine

65% want one engine (as compared with 33% two-engine fans) of the following specifications:



Air-cooled, horizontally-opposed 57%; Liquid-cooled 6%; Air-cooled in line 21%; Radial 12%; Geared 27%; Direct 38%.

Cylinders: Four 14%; Six 32%; Seven 3%; Eight 6%; Nine 2%; Twelve 2%.

Horsepower: Less than 100, 28%; 100-150, 42%; over 150, 29%.

Both in specification and price, the Franklin engine is the preferred power plant for the postwar plane you want.

People are seriously thinking about postwar flying. That is proved by the fact that our "postwar plane questionnaire" drew replies from one out of every four who received it. 55% of these have no connection with the aviation industry.

Most of these volunteer "specification writers" (87%) prefer a monoplane. 51.3% want low wings. 64.5% said to make it a straight land plane.

The engine chosen by 57% is air-cooled, horizontally-opposed, with 32% preferring 6 cylinders.

68% want retractable landing gear, and 51% prefer the tricycle to the conventional two-wheel (10%). 46% specify fixed wings, although 29% are interested in folding or detachable wings for roadability. 55% want metal fuselage, and 48% metal wing covering. Cruising speeds of 115-150 mph are preferred by 59%; landing speed, 40-50 mph; cruising range, 400-600 miles.

Seating capacity, 4 persons; 25-50 lbs. baggage per person. 75% ask for wing flaps and 37% for slots. Accessories will include electric starter and generator, magneto ignition and radio receiver and transmitter.

Preferred cost is about $2500, and 84% will use their planes for combination of business and pleasure. The summarized questionnaire gives these and other preferences in detail.

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With eager markets waiting for many products, time is the most valuable commodity in turning to consumer production.

Many of the war born developments, designs and production short cuts here at Pollak will save time and expense for American manufacturers in the future.

We have discussed them with many executives and engineers, and as a result, we have a number of mechanical parts and complete assemblies awaiting material and manpower releases.

But Pollak capacity is large. Five plants and nearly 5000 employees will enable us to absorb the development, designing and manufacture of still more metal products.

Pollak experience, and techniques in metal working, particularly the less common metals, will help you condense years into hours—if we can serve you. Let us plan with you to make Pollak facilities your facilities to save time and money.

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principal characteristics of air transport into consideration and claiming that the war has changed the scope of aviation from a regional to an international problem, he makes some suggestions for the future. Among these are the introduction of a common international aviation terminology, a world-wide meteorological service, the standardization of airport and air-route installations, and the institution of international air navigation rules. To establish and carry out these innovations he advocates a World Civil Aviation Authority. The writer also offers some observations on methods of reducing air transport's costs, the development of equipment, and competition in airline routes. *The Aeroplane*, July 21, 1944, pages 65, 66.

A Preface to Postwar Planning. Part VII. George E. Haddaway. The seventh article in a series discussing the various problems that require solution in the establishment of a sound postwar aviation program for the United States is devoted to the question of surplus-aircraft disposal. In it the writer denounces as detrimental to postwar aviation the present trends of governmental agencies in handling the disposal of surplus airplanes. He claims that most of the aircraft being sold by the Government to the public are not only substandard but also command too-high prices. He states also that basic principles recommended in the Harvard University report on "Disposal of Surplus Aircraft and Major Components Thereof" (which are outlined in the article) are not being followed.

In the interests of future aviation, the writer suggests that the Government turn over the entire task of surplus airplane disposal, including the disposal policies, to the C.A.A. He believes that this course will facilitate the release of airworthy, C.A.A. certificated aircraft to the flying public at reasonable prices. *Southern Flight*, August, 1944, pages 24, 25, 48, 1 illus.

World Transport Aviation. Joseph B. Hubbard. An article in which the position of the air transport industry is discussed and its prospects for the future are surveyed. A statistical review of the development and expansion of the industry first is presented. Curves show the miles flown by carrier planes from 1926 to 1943 for the entire world, the United States, and the United Kingdom. A table contains selected statistics about the operations of the scheduled air lines in 1938, and the annual rate of gain from 1930 to 1938, classified by countries. The outlook for the air transport industry is discussed in sections dealing with the range of use, political elements, technical aspects, costs, and the meaning of airplane speeds. In conclusion, it is stated that the industry will return to peace conditions under new laws and international arrangements that are only now beginning to be worked out. Evidence points to the fact that transport aviation is in an early stage of economic growth, with the implication that its advance will continue to be rapid. Meanwhile, the plane has been developed to a technical form that may prove basically stable for some years to come and hence facilitate the expansion of its commercial use. *Harvard Business Review*, Summer, 1944, pages 509–515, 1 illus.

Private Flying

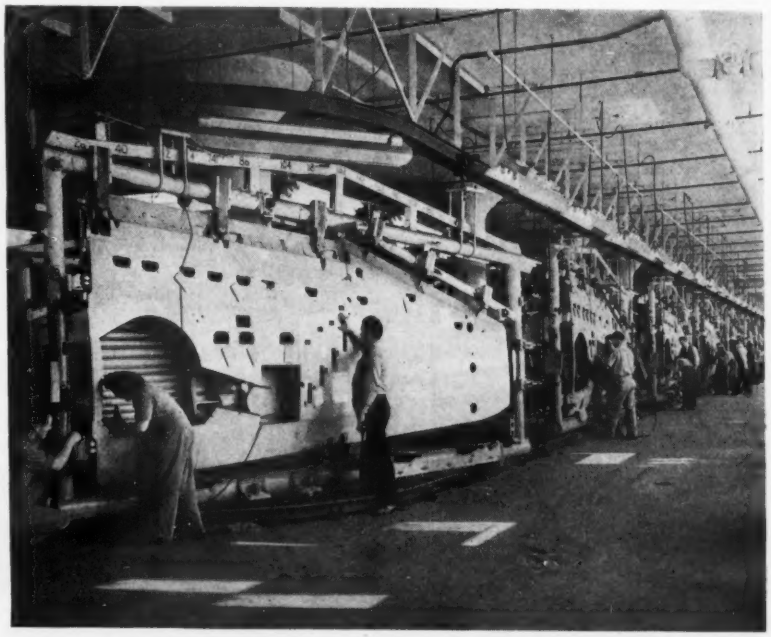
Postwar Sporting Flying. Moorhen. Indicating how aviation might be popularized through sporting flying, the writer suggests the postwar inauguration of aerial sporting events calculated to interest, instruct, and entertain the spectators. He particularizes the types of events and how they would take place. With the idea that interest in airplane competitive meets should vie with the public's interest in horse racing, football, etc., the writer also demonstrates how events would stimulate developments in aircraft components and accessories. *The Aeroplane*, July 14, 1944, pages 44, 45, 2 illus.

Roadable Plane's Utility Compared with That of Pure Aircraft. The writer discusses two schools of thought regarding the design of utility aircraft, one supporting the "roadable plane" and the other the "pure aircraft." The points of view of both schools are outlined in sections dealing with strictly air-going vehicles and with all-purpose vehicles. Other sections discuss the trend toward utility as a prime requisite for private aircraft, the aircraft mortality rate or short length of ownership, and the advantages of the small flying boat with auxiliary retractable wheels. *Aviation News*, August 28, 1944, pages 11, 12.

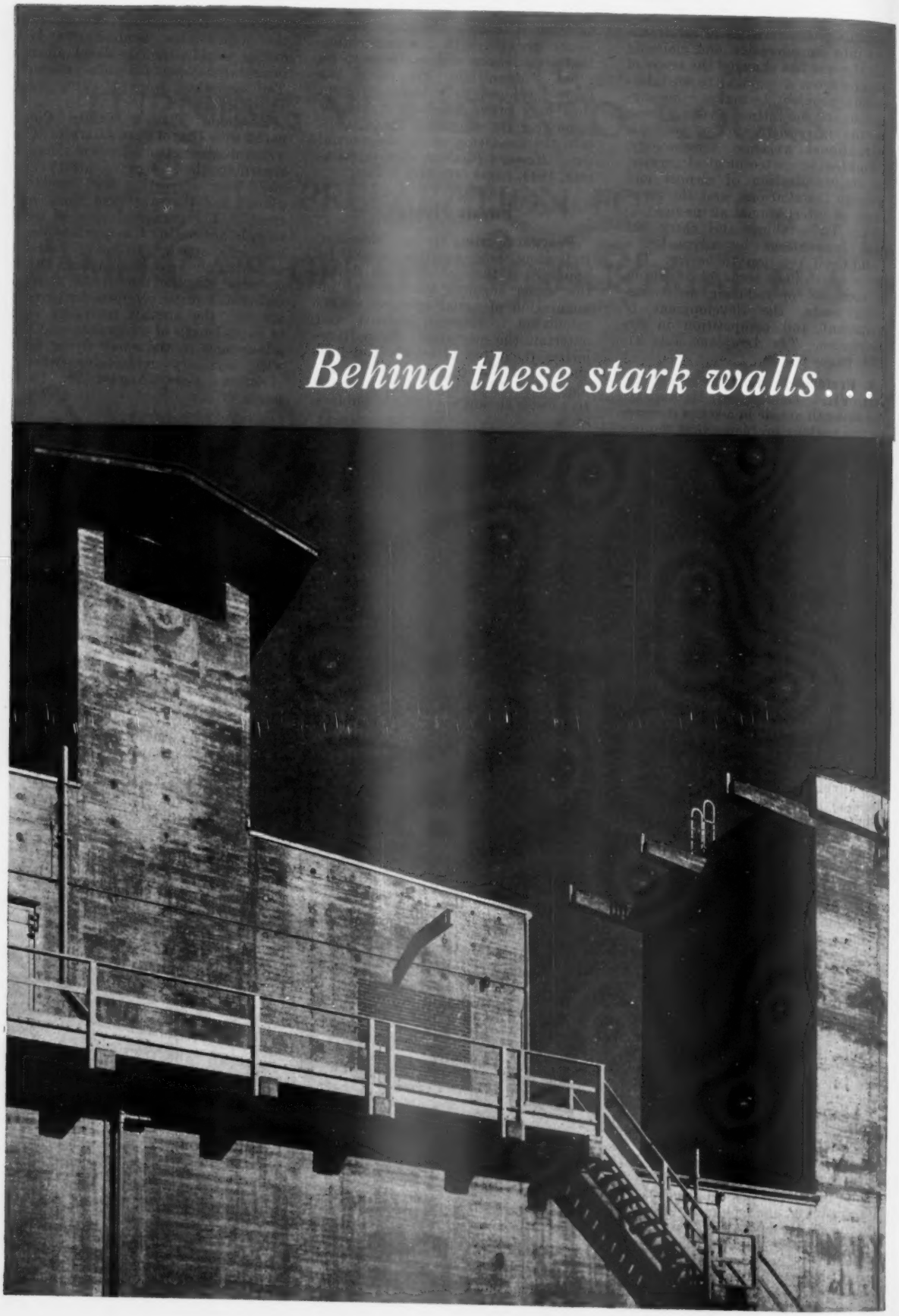
Production

The Ordered Flow of Materials at the Willow Run Plant. Franklin M. Reck. A comprehensive review of the system used at the Willow Run plant for controlling the material and parts that go into the Liberator bombers produced there, so that all parts and subassemblies arrive at the assembly lines precisely as needed. Preceded by a general description of operations at Willow Run, the review covers the two main aspects of the system, scheduling and flow. Under scheduling, such factors as the inventory of parts on hand, manufacturing time cycle, and model changes are discussed. Under flow, the methods that have been introduced at Willow Run for the scheduled moving ahead of parts and for the control of each department in a manner to prevent shortages are examined. Other phases of the system that are particularized include the transportation of parts, arrangement and practices in stock cribs, and the receiving and handling of purchased finished stores.

The key to this material-control scheme is reported to be a master numerical parts and reference list. Compiled by the Material Department, which is charged with the opera-



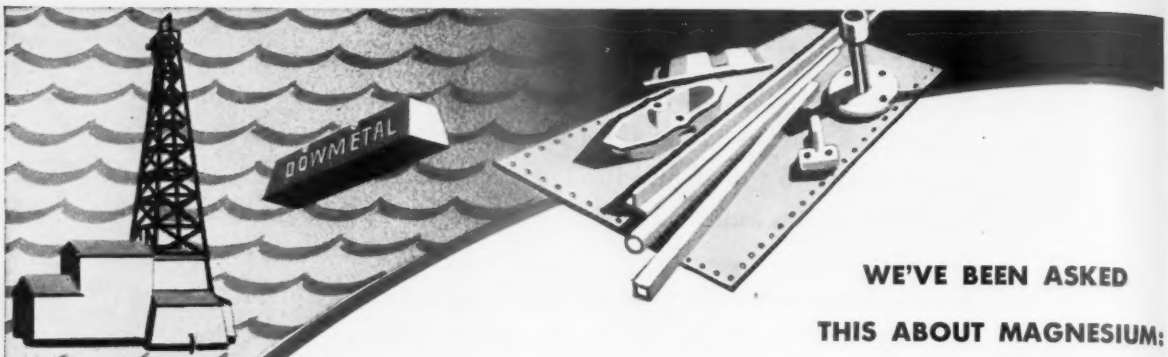
The aft and leading-edge section subassemblies of a Republic P-47 Thunderbolt joined to form a complete inner wing section at the Murray Corporation of America's Aircraft Division.


Behind these stark walls...

Even against the weird landscape of a modern refinery, it is an architectural oddity, a windowless dwarf of a building, a runt in comparison with its towering neighbor the "Cat Cracker."
But it wasn't to win architectural awards that this squat concrete cell was built and stoutly anchored on a 9-foot thick bed of concrete.
This is an aircraft engine testing laboratory unlike any other in America. Here engines will be run to the death not to test the engine but the fuel.
It will handle anything up to 3,000 horsepower. And throughout, from its vibration-proof control room floated on cork

The new limits of new Aviation Fuels will be explored in the Petroleum Industry's First full scale Engine Testing Laboratory

to its 50,000 cubic feet per minute exhaust fan its equipment is the last word.
Controls are electronic, tempered air for carburetion will be supplied at 4" mercury pressure. Instead of the normal 4 checks on temperatures within an engine . . . there will be 186 thermocouples. We'll get fractional horsepower ratings. We'll run engines far above their rated power to test the limits of the new fuels that come from our laboratories.
It is the first full-scale engine testing cell in the petroleum industry. It will enable us to set up the first uniform testing method to get fuel ratings and full-scale data.
And it will be bound to increase the contributions we make to the science of aviation fuels.



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Dow is the pioneer and major producer of magnesium . . . the principal developer of its alloys and fabrication techniques . . . and the leading sponsor of its widespread application in many fields of industry. So it is only logical to consult Dow relative to any phase of the usage of the lightest of all structural metals.

- Forgings
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- Extrusions: Bars, Rods, Tubing, Special Shapes
- Sand Castings, Permanent Mold Castings, Die Castings
- Construction of Welded and Riveted Subassemblies
- Sheet, Plate and Strip
- Technical Service

The broad range of Dow magnesium activities *begins* with the extraction in large quantity of the virgin metal from Michigan brine and from the waters of the sea . . . it *includes* production of a complete line of Dowmetal Magnesium Alloy ingots and an accompanying line of fluxes and protective agents . . . it *extends* to complete mill and foundry facilities for cast and wrought products and a jobbing fabrication shop for stamping, drawn parts and assemblies . . . all *supplemented* with the knowledge accumulated in 28 years of experience in engineering and metallurgical research.

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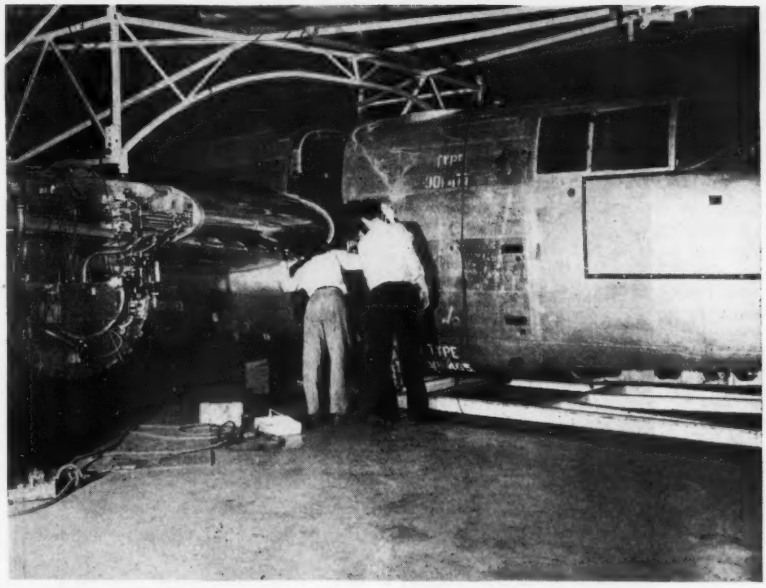
tion of the system, this list tabulates all the parts, past and present, that were or are used on the B-24. It describes the items and indicates into what part of the plane each piece goes, how many are used per plane, the departments through which the parts must be routed in manufacture (or the source if purchased outside), and the subassembly into which the piece is incorporated. It also contains the record of all rough stock, identifying the stock with parts made from it, and the shop department where work begins on the stock. *Aero Digest*, August 1, 1944, pages 68–74, 142, 12 illus.

Steel Castings for Aircraft. The employment of steel castings for aircraft production is exemplified in an account of how the oleo leg pivot bracket for the Hawker Typhoon is manufactured. Techniques described are those of Hadfields, Ltd. Particulars are given on the molding procedure and equipment, the cores for making the castings and the methods of assemblying the cores, the properties of the sand from which the molds are made, and the control system that regulates the quality of the castings. For the nondestructive testing of the castings, the methods of radiography and electromagnetic detection of surface flaws adopted by the company are noted. *Aircraft Production*, August, 1944, pages 359–361, 8 illus.

Relative Costs of Parts Made by Five Different Methods. Supplementing a previous article comparing costs of production with different casting methods, this article analyzes the relative costs of parts made by forging, sheet-metal forming, screw machine, permanent-mold casting, and flame cutting. Components dealt with include a landing-gear attachment, torque-tube collar, hook assembly, and extension-shaft arm. *Product Engineering*, August, 1944, pages 536–540, 4 illus.

How to Manufacture Rolled Kirksite Blank and Pierce Dies. C. H. Bodner. The manufacture of Kirksite blank and pierce dies on a production basis is described. It is noted that many aircraft companies have been able to take advantage of the economies of punch-press production by using rolled Kirksite "pancake"-type blank and pierce dies. By standardizing on a uniform style of construction and dividing the work into single repeat operations, inexperienced help can be quickly trained to make these tools since it is only necessary for each person to learn a single operation.

It is stated that ten men can complete approximately 20 dies per day. Information is furnished about the basic parts required and the equipment needed to manufacture the punches and dies. It is explained that Kirksite blank and pierce dies can be made entirely without drawings by supplying the tool-fabrication department with a small pamphlet outlining the procedure to be followed. *Industrial Engineering*, September, 1944, pages 14–18, 9 illus.



The center and front sections of the fuselage of a North American B-25 being mated. The front section, to the right, is rolled into place on a roller conveyer.

The Production of Aircraft Stampings. The first of two articles detailing the manufacturing methods and laboratory control techniques of High Duty Alloys, Ltd., in their production of stampings for the aircraft industry. Part I traces the manufacturing sequence. It also emphasizes the importance of strict laboratory control on the quality of production and tells how this is effected. Laboratories are described and several methods of laboratory analysis are reviewed. These methods include colorimetric, electrochemical, and spectrographic analyses. *Aircraft Production*, August, 1944, pages 362–368, 18 illus.

Bell Puts Teeth Into Quality Control. Herbert Chase. Quality control as applied at the Niagara Frontier Division of the Bell Aircraft Corporation is described. Reference is made to economies in labor and materials accomplished with the method. It is explained that the system provides rewards for good work and penalties for indifference. Inspection operations are broken down into elements so simple that a large part of the inspection force requires relatively little experience to function efficiently. Records are such that responsibility is placed where it belongs, so causes of faults can be determined. *Wings*, September, 1944, pages 1181–1185, 8 illus.

Machining Helldiver Components. R. Eric Crawford. A series of notes refer to the operations of the Point St. Charles Division of the Canadian Car and Foundry Company, where components of the Curtiss Helldiver are machined before final assembly at the Fort William plant. The chief tasks performed by the Point St. Charles works are the production of landing gear and the machining of the large forgings that make up the M-frame, the A-frame, wing-hinge fittings, landing gear truss, the hydraulic cylinders with their allied parts, the curved tracks for landing flaps, etc. Several instances of machine setups and various machining procedures are described and illustrated. *Canadian Aviation*, August, 1944, pages 62–64, 8 illus.

Gabriel Products on Military Vehicles and Warplanes. Joseph Geschelin. War production activities of an automotive shock-absorber manufacturer are described. Among the products now being manufactured are hydraulic cylinders for military aircraft applications, which include gun turrets, wing-control flaps, and landing struts. Manufacturing operations and equipment are described. *Automotive and Aviation Industries*, August 1, 1944, pages 22–25, 150, 9 illus.

Employment of Operations Manuals in Factory Production Control. This is an article on the factory procedures manuals issued and used by the St. Louis plant of Curtiss-Wright Corporation. It describes their contents as well as their purpose and operation as a production facility, an instruction medium, and an active means of management control. As related, the manuals are all uniform in outline and are divided into the following headings: (1) instructions, (2) procedures, (3) forms, (4) organizations, (5) personnel, (6) equipment, (7) duties, (8) methods, (9) reports, and (10) data. Under each of these headings, loose-leaf sheets are filed for reference. When action has been completed or any of these sheets are obsolete or superseded by others, they are

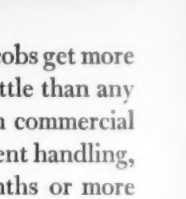
1) *Add gas as needed . . .*
2) *Bring oil up to gauge levels daily . . .*
3) *Forget it . . .*

And that's about all a Jacobs needs for six months or so!

After a thousand flight hours, some Jacobs engines need a major overhaul—and some don't. (AAF regulations once specified 350 hours maximum, were relaxed by degrees.) And a major overhaul usually shows some worn piston rings, and a few minor replacements . . . Because these engines are designed right, with the fewest possible parts, which fit and function perfectly; were proved and improved in pre-war commercial flying; and have added stamina, as materials improved.

In instruction flights, the Jacobs get more take-offs, more time at full throttle than any engine in combat service—or in commercial operations! And even with student handling, deliver dependably for six months or more between major overhauls.

THE war record of this engine rates Jacobs as an important factor in postwar flying, private or commercial . . . Largest makers of aircraft engines of medium power rating, Jacobs will have postwar models fit for anything from light planes to cargo carriers . . . and well worth the consideration of plane owner and airline operator . . . Inquiries are invited . . . Jacobs Aircraft Engine Co., Pottstown, Pa.



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removed for file or destroyed, so that the book is always kept up to date. *Aero Digest*, August 1, 1944, pages 84, 85, 142, 4 illus.

Aircraft Riveting Problems. Emric W. Berger. An article on the minimizing of handling difficulties encountered in aircraft riveting, based on a paper read at the Annual Aviation Division Meeting of the A.S.M.E. at Los Angeles in June, 1944. It is noted that no method has yet been approved to take the place of riveting for primary aircraft structures. Reference is made to the large number of man-hours spent in replacing so-called improperly driven rivets. Information is given regarding studies made to establish criteria for determining the limits of acceptability. It was found that in many cases the replacement of rivets does not result in making joints any stronger and that the original rivets are better than those that replace them. Almost 60 per cent of drilling-out operations result in enlarged elliptical holes. Replacement rivets do not swell to fill the hole completely. Other riveting problems and their solutions are described. *Industrial Aviation*, August, 1944, pages 48–50, 52, 71, 8 illus.

Empennage Components. R. Eric Crawford. A survey of the methods by which rudders, elevators, tail fins, stabilizers and fuel-tank flaps are fabricated for the Curtiss Helldiver. The routines described are those of the Montreal Aircraft Division of the Canadian Car and Foundry Company. Details are given about the machinery employed as well as the procedures followed. *Canadian Aviation*, August, 1944, pages 89, 90, 94, 6 illus.

High-Strength Aluminum-Magnesium Alloy Castings. Comdr. H. F. James. The writer discusses briefly the manufacture of high-strength castings from 10-per cent magnesium-aluminum alloy to which D.T.D. Specification No. 300 relates. The specified minimum properties of this alloy as obtained from a standard sand-cast test bar are listed. The technique for the successful production of castings is described. *The Engineer*, July 7, 1944, page 15.

Production Control: The Production Plan. D. Tiranti. The writer gives his interpretation of what is meant by the production plan. He then shows how the plan can be applied in a practical manner in any engineering organization. *Aircraft Engineering*, July, 1944, pages 205–208, 4 illus.

Joiner Versatility. This is an article on the production of the Spitfire's metal rudder by a firm that formerly engaged in architectural joining. Fabrication of the rudder's smaller parts, as well as of the spar, are detailed. Procedures of assembling the structure are outlined also. Attention is called to the fact that all jigs and tooling equipment have been designed by the former woodworkers.

Aircraft Production, August, 1944, pages 373–376, 11 illus.

Hole Piercing Proves Faster—and Cheaper. Part II. Herbert Chase. Concluding half of a two-part article reviewing The Glenn L. Martin Company's methods of utilizing punch-and-die procedures for piercing rivet holes. Part I gave the advantages of the technique over drilling for certain applications and told how the Martin company combined it with a conveyer belt line system to simplify and facilitate the production of small assemblies. In Part II it is shown how the same basic automatic riveting methods are applied for larger assemblies and extrusions, although handling procedures are different because of the sizes of the parts and assemblies. It is reported that in the case of the larger components even greater economies are effected, since the number of rivets per piece is larger. *Aviation*, August, 1944, pages 161, 162, 4 illus.

Building the Helldiver. R. Eric Crawford. This article deals with the production methods used by the Canadian Car and Foundry Company, Ltd., to manufacture Curtiss Helldivers. Beginning with the problems of converting the plant from production of the Hawker Hurricane to production of the Helldiver, it goes on to present details about the assembly processes and equipment of the Fort William plant that enable the Canadian company to turn out quantities of the Curtiss plane for the U.S. Navy. Production features and innovations in airplane-manufacturing procedures are noted. The article also includes descriptive data about the Helldiver and illustrations of the discussed factory methods. *Canadian Aviation*, August, 1944, pages 54–57, 102, 104, 107, 108, 21 illus.

Robots Control Airacobra Materials. Gustav Maass. A description of how the Bell Aircraft Corporation has made use of punched cards and tabulating machines to handle materials control under the conditions of a rapidly increasing volume of engineering changes. *Wings*, September, 1944, pages 1191–1193, 5 illus.

Method of Maintaining Smoothness of Airplane External Surfaces. A. H. Petersen. This article deals with the elimination of surface bumps and dents in aircraft. Notes are furnished on design, riveting, spotwelding, and the use of organic finishes contributing to the production of smooth surfaces. Illustrations show methods used for the production of surface smoothness at butt joints and the tooling for spot welding leading edges. *Automotive and Aviation Industries*, August 15, 1944, pages 18, 19, 104, 106, 5 illus.

Cutting Production Time by Multiple Riveting. J. E. Cooper. A description of how the use of eight-gang riveting machines for riveting outer panel spars and spar caps for the Liberator is saving man-hours and reducing rivet rejections. It is stated that no particular training of men and women is required for the new method of riveting. Riveting spar caps to the web requires only one operation. *Industrial Aviation*, August, 1944, pages 44, 68, 69, 2 illus. "Multiple Riveting of Aircraft Parts," by J. E. Cooper, *The Iron Age*, August 24, 1944, pages 56–58, 6 illus.; "Line Rivets Up—Then Gang 'Em," by J. E. Cooper, *Wings*, September, 1944, pages 1194, 1195, 4 illus.

Designing Castings and Forgings. Part III. James E. Thompson. The third article in a series on the design of aircraft castings and forgings is concerned with the design considerations and processing methods of forgings. In detailing how the forgings are made, attention is called to the avoidance of irregular sections, the construction of fillets and corner radii, the provision of lightening holes in the web areas, and forging tolerances.

Fundamental design considerations are that (1) the part be divisible by a longitudinal "parting line" into two portions, with all surfaces drafted away from each side of this line; (2) this parting line provide either an approximately equal volume of metal at each side, or all the metal on the bottom of the parting line; (3) the forging be designed to avoid "backdraft" that prevents die separation; (4) highly irregular and complicated sections be avoided; and (5) the overall dimensions and weight of the forging be kept within the capacities of available forge shops. However, it is stated that if the forging is to be practical and economical the following factors must also be regarded as important: (1) proper draft, (2) adequate fillet and corner radii, (3) proper wall thickness, (4) elimination of extreme projections and bosses, (5) minimum section variations, (6) elimination of confined or restricted areas, (7) adequate finish allowance, (8) practical forging tolerances, (9) elimination of left- and right-hand forgings of the same part, and (10) use of identical forgings for similar parts. *Western Flying*, August, 1944, pages 62, 64, 66, 68, 122, 11 illus.

Air Power That Wins! The second section of *Machinery's* seventh annual aircraft production number occupies the better part of the August issue of the magazine. It contains a group of articles giving detailed information about various aircraft-pro-

duction operations. The articles and the authors are as follows: "Wright Aero Products Engines for the B-29 Superfortresses," by K. E. Sutton, Manager, Wood-Ridge Plant, Wright Aeronautical Corporation; "Ford's Centrifugal Casting Production Line"; "Working to 'Tenths' on the Sperry Aircraft Gyropilot," by George A. Richroath, Factory Superintendent, Nassau Plant, Sperry Gyroscope Company; "Casting Rolls Royce Cylinder Blocks in Buick's $10,000,000 Aluminum Foundry," by William G. Mixer, Foundry Superintendent, Buick Motor Division, General Motors Corporation; "Forming and Welding Curtiss Hollow Steel Propeller Blades," by Holbrook Horton. *Machinery*, August, 1944, pages 133–180, 79 illus.

Limits of Formability for Sheet Magnesium Parts. P. A. Nagy. An article setting forth the results of tests conducted by Consolidated Vultee for the purpose of obtaining factual data to guide engineers in the design of sheet magnesium parts. The forming qualities of four magnesium alloys formed by the Guerin process are presented. Recommendations are made for the design of formed sheet magnesium parts for aircraft. The results of the investigations, which covered flanges, joggles, beads, and lightening holes, are summarized. Tabular data include recommended bend radii, shearing stresses for holes and cupping depths for flanged holes. Relations between high forming temperatures and physical properties and between sheet thickness and bend radii are shown graphically. *Product Engineering*, August, 1944, pages 529–533, 9 illus.

Now They Roll Out the Pinions for the "Flying Fortress." As told to Chester S. Ricker by C. M. Loomis. How the use of conveyers has cut man-hours and increased the overall production of the Flying Fortress at the Detroit plant of the Murray Corporation is described. It is noted that in many instances the original stationary fixtures were merely conveyerized. The new system is compared with the one formerly used. *Wings*, September, 1944, pages 1186–1189, 11 illus.

Production Improvements That Raised Bomber Output at Kansas City Plant. Gerald Eldridge Stedman. The writer tells how man-hours and floor space were utilized at the Kansas City plant of North American Aviation, Inc., to raise the production of the B-25. It is explained that the entire enterprise is operated in such a way as to put into immediate use any changes that will improve production. Engineering methods are altered as frequently as may be necessary to meet new conditions as they arise. Time and motion savings, cost reduction, increased production speed, and flow have resulted, with great improvements in procedure. Some of the practices and methods are described in detail. Various production operations and equipment are illustrated. *Automotive and Aviation Industries*, August 15, 1944, pages 20–23, 76, 78, 80, 9 illus.

Helldivers by August. E. J. Wilkinson. Features characterizing the production of Curtiss Helldivers by Fairchild Aircraft Ltd. are described. In addition to information about the Canadian company's fabrication and assembly methods, the article contains data on the preliminary planning and tooling that were required before the company could manufacture the Helldiver, the meeting of modifications for the current model of the plane, and the production of spare parts. Illustrations of the assembly methods are shown. *Canadian Aviation*, August, 1944, pages 58–61, 96, 98, 12 illus.

Design of Powdered Metal Parts. W. H. Arata. As a guide to the design of machine components, information is given regarding the advantages, limitations, and physical properties of powdered-metal parts. Typical applications of powdered-metal parts are shown. Tables give the physical properties of bronze, iron-copper, and iron powdered metal in sintered condition, and the commercial tolerances for pressed powdered-metal bearings. It is stated that the use of pressed powdered-metal parts has increased rapidly because the physical and chemical properties of such parts can be controlled to meet the needs of specific applications, and the finished parts require little or no machine work. *Product Engineering*, August, 1944, pages 561–564, 4 illus.

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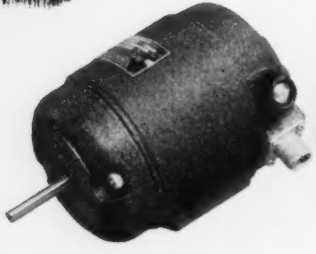

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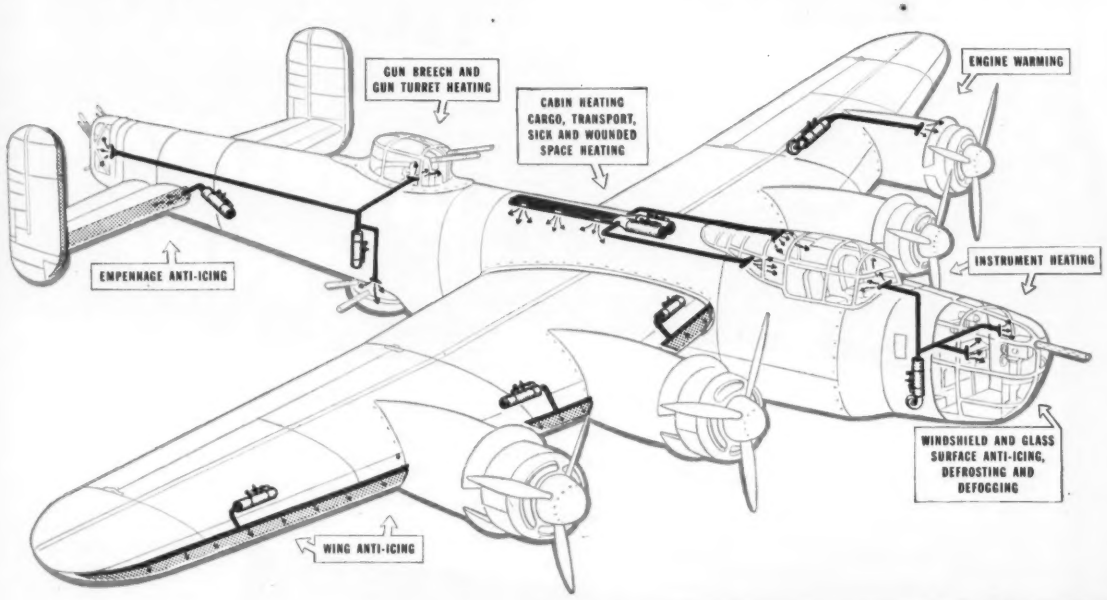
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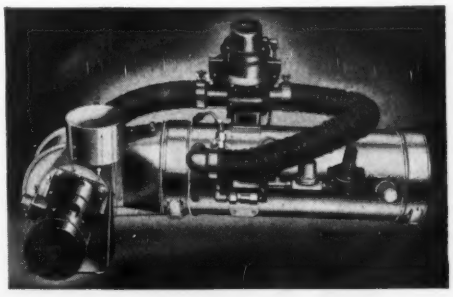

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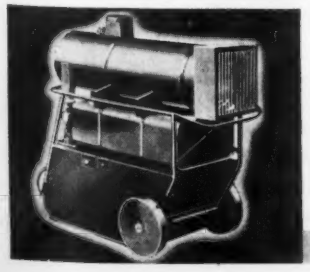

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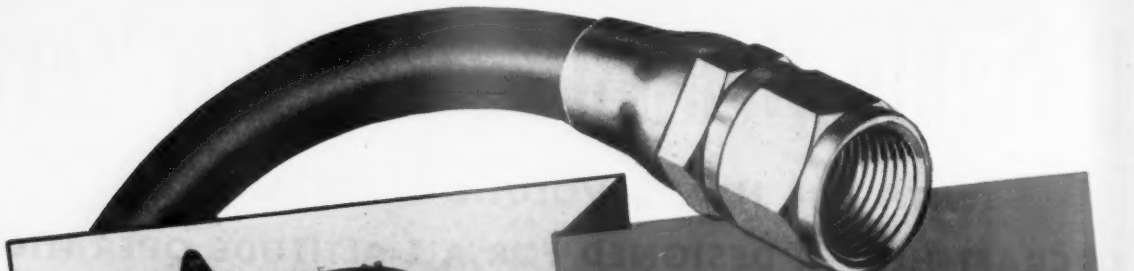

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Propellers

Screws and Airscrews. T. H. Day. In this article the writer makes an analytical comparison between the screw thread and the propeller. A comparison first is made between the system of forces acting on an airfoil section and those acting on an inclined plane. Consideration then is given to the forces acting on the airscrew under different conditions. The efficiency of the inclined plane is then compared with that of the propeller. *Aircraft Engineering*, July, 1944, pages 191–194, 13 illus.

Particulars of the German VDM Electric Propeller. John D. Waugh. A study of the VDM propeller, which is used almost exclusively on operational aircraft in the German air force. The writer finds that the propeller is versatile, well designed, and well constructed, but is not superior to comparable British and American units. He states that the pitch-change rate of the model described is inadequate for high-performance aircraft, but the propeller is easily and quickly disassembled and serviced. The model is easy to manufacture, but because of the large numbers of small parts takes longer for inspection and assembly than American propellers. He concludes that the VDM spinner is superior to American spinners, at least from the standpoint of removal and installation, and therefore is worthy of further study. *SAE Journal*, August, 1944, pages 348–358, 392 (Transactions), 28 illus.

Long Life for Your Wooden Props. Specific procedures for the maintenance of wooden propellers are given in this article. Routines to be followed in daily, 25-hour, and 100-hour inspections are outlined, and advice is given on overhaul methods. Overhaul suggestions pertain to repair of dents and scars, restoration of tipping, repair of damages to laminations, and elimination of vibration. *Aviation*, August, 1944, pages 174–177, 251, 252, 22 illus.

Radio

The Development of a New Station Location or Z-Marker Antenna System. J. C. Hromada. This paper contains descriptive and flight-test information relating to a new type Z-marker antenna system that is stated to possess a number of marked advantages and improvements. It is explained that the antenna consists of two spaced-dipole arrays, crossed at right angles to each other, and excited in quadrature time phase. The design of the arrays is based on the principles of proportioning dipole currents in accordance with the coefficients of the successive terms of the binomial expansion.

It is stated that the antenna is of simple and rugged design, capable of maintaining a high degree of marker-zone stability under rain, snow, and sleet conditions, and lends itself to prefabrication in units and sections of transmission line for ease in field installation. The marker zone is considerably narrower than the zone provided by present Z markers and is well suited to instrument approaches. Whereas the height of present Z markers is limited to about 10,000 ft., the new marker antenna may readily be extended to over 20,000 ft. altitude with present transmitting equipment. *Proceedings of the I.R.E.*, August, 1944, pages 454–463, 17 illus.

Radio Controlled Aircraft. It is stated that while the robot planes Germany has been using are not radio controlled, it is no secret that the Germans have, in some questionable state of perfection, full-sized airplanes that are radio controlled. Early experiments conducted by Germany, Britain, and the United States with radio-controlled planes are reviewed. The possibilities of remote-control flight for commercial uses are considered. *Air News*, September, 1944, pages 46, 47, 4 illus.

Radio Installation Procedure. William P. Lear. The third and final article in a series on radio equipment for civilian aircraft. Offering advice as to the most efficient methods to be followed, Part III outlines procedures for installing aircraft-radio receivers, transmitters, and direction finders. The installation of three different types of receivers is described: the direct-control type, the partial remote-control type, and the full remote-control type. Information about the shielding and bonding of installations is included. *Air Pilot and Technician*, August, 1944, pages 21–23, 36, 5 illus.

Reaction Propulsion

Gas Turbine Development—Past and Present. F. M. Heldt. The writer reviews the developmental work that has been carried out on gas turbines for various services, including aircraft superchargers. It is noted that despite the fact that much study and experimental work has been devoted to the gas turbine, as yet it has made little practical progress. The present lack of gas-turbine applications in the transportation and central-station fields is ascribed to the difficulty of obtaining the thermal efficiency obtained from other available prime movers. To explain this lower efficiency, the operating principle of the gas turbine is described and factors that limit the output efficiency of the gas turbine are analyzed. Consideration is given to the two basic types of gas turbine, known respectively as the constant-volume and the constant-pressure type. It is noted that at present most developmental work is being concentrated on the constant-pressure type. The operating cycle of this machine is described with the aid of the pressure-volume diagram. Closed-cycle gas turbines are also discussed.

With reference to aircraft service, it is stated that there may be a demand for gas-turbine units of 5,000 to 8,000 hp. because the production of such power outputs with the present type of engine would require an excessively large number of cylinders. With present materials used in a simple turbine of the power capacity currently needed, it would seem to be impossible to equal the thermal efficiency of the modern aircraft engine. The fuel required for gas turbines is claimed to be cheaper and safer than high-octane gasoline and this advantage might compensate for a certain inferiority with respect to thermal efficiency. *Automotive and Aviation Industries*, August 1, 1944, pages 26–30, 54, 56, 58, 60, 64, 8 illus.

More German Explosive-Carrying Pilotless Aircraft. Information is furnished about recently identified reaction-propelled flying bombs. It is stated that the existence of a curved-wing type has been confirmed and the indications are that the wings are elliptical. The wings are swept back, which has resulted in this type of flying bomb being nicknamed "The Butterfly." Reference is made to a new version of the flying bomb, which is the seventh to be identified, and which is similar to the third type identified except for a slight taper on the trailing edge. Two methods of limiting the ranges of flying bombs, and two methods of detonation which the Germans now appear to be using are described. *The Aeroplane Spotter*, page 158, 3 illus.

Rotating Wing Aircraft

Autogiro on Patrol. Tom Ashley. An account of how autogiros are used along the Mexican-United States border to combat smuggling and the illegal entry of aliens into the United States. It is also indicated how the development of rotary-wing aircraft is furthered in this process of utilization by the Department of Justice. *Southern Flight*, August, 1944, pages 22, 23, 46, 48, 7 illus.

Stress Analysis

The True Stress-Strain Tension Test—Its Role in Modern Materials Testing. Part I. C. W. Macgregor. The fundamentals of the true stress-strain tension test are discussed. The applications of this form of tension test in revealing the effects of different mechanical and metallurgical conditions on fundamental material properties are dealt with in considerable detail. The paper discusses both mechanical and metallurgical conditions.

The first installment discusses the true strain values used in the tension test; the different methods available for determining true stress-strain curves; the true stress-strain curves resulting from the use of these methods; the ductility values based

One of the many vital processes that give Machlett vacuum tubes their remarkable quality is a novel method of casting electrodes in a vacuum. Anodes for X-ray tubes, and complex parts of high-frequency oscillators are made by this unusual technique. Purified copper rod is placed over a mould in a graphite crucible, and the whole enclosed within a double-walled water-cooled quartz-silicon tube, which is encircled by a high-frequency coil. A vacuum of about 10^{-5} mm. of mercury is maintained.

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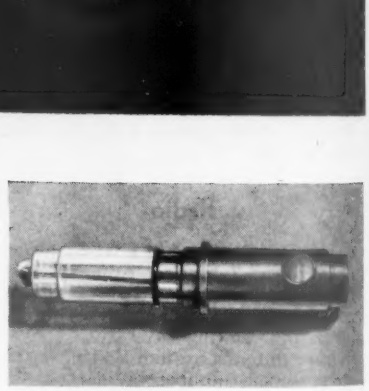

EG-50—an X-ray tube with beryllium window for radiography of light materials and thin sections.

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on true strain; and the effects of various mechanical conditions on true stress and strain values, such as high and low testing temperatures, the velocity of testing, and the proportions of the test bar. *Journal of the Franklin Institute*, August, 1944, pages 111–135, 15 illus.

Automatic Recording of Data Speeds Structural Testing Work. Albert Epstein. An account of research work conducted by Republic Aviation to speed the structural testing of materials. Testing techniques that simplify the measurement of the compression yield strength and the compressive stress-strain properties of sheet or light extruded material, and the determination of deflection in riveted and spot-welded joints were developed. Illustrations show an extensometer and jig used in determining the compression stress-strain characteristics of light gauge materials, the test setup of the sheet in the compression jig, an extensometer with test specimen as used to take measurements of joint deflection, a dial gauge setup used to measure joint deflection to failure, and a dial gauge attachment to record deflections measured by the gauge. A chart shows compression stress-strain record for sheets of artificially aged aluminum alloys. *Product Engineering*, August, 1944, pages 557–560, 6 illus.

Berechnung der duennen Kreisplatte mit grosser Ausbiegung (Calculation of a Thin Circular Plate Which Has a Wide Deflection). Karl Federhofer. For the studies discussed in this paper, a thin circular plate with fixed rim is uniformly loaded. The deflection of this plate exceeds its thickness several times. Relations between load, deformation, and stress are represented in formulas which make possible the construction of two curves for practical use. At a given load and at known dimensions of the circular plate, maximum deflection and maximum demand imposed on the plate material may be directly read off these curves. Simple approximation formulas are then developed for circular and annular membranes. These formulas closely approach the strict solutions which may be represented only by the development of series. With the aid of the figures given in two tables such membranes may be directly calculated. *Luftfahrtforschung*, February 28, 1944, pages 1–10, 6 illus.

Superchargers

Rotol Cabin Supercharger. Details are given on the construction and operation of a pressure cabin supercharger developed by Rotol, Ltd. Affording a means of maintaining the interior of the aircraft cabin at an air pressure corresponding to the atmosphere at 10,000 ft. while flying at any height up to 40,000 ft., this supercharger also keeps the cabin interior at a comfortable temperature all the way up to the aircraft's ceiling. It is

Photograph Courtesy Ford Motor Company

A comparison of the strength of centrifugally cast and forged cylinder barrels under hydraulic pressure. The centrifugally cast barrels show greater strength under hydraulic testing.

attached to, and driven by, the inboard main engines. Of the displacement type, the Rotol cabin supercharger has two spindles running inside an aluminum casting and carrying two rotors that interact upon each other without actually touching each other or the casing. The driving gear oil seal is separated from the pumping chamber by an annular space drained and vented to the outside atmosphere in order to prevent oil from entering the blower chamber and producing contaminated air conditions in the cabin. With the pumping charger spindle sealed by a non-rubbing, steam-turbine type of labyrinth, the latter is fed with compressed air bled from the supercharger delivery. At the sacrifice of some air, this system insures that at all times there is "one way traffic" of air flowing from the pumping chamber out through the drain. *Flight*, July 20, 1944, pages 72, 73, 2 illus.

Testing Equipment

Role of the Thermal Conductivity Cell in Aircraft Instruments. Part I. Michael A. Picciano. The equipment known as the exhaust-gas analyzer or the fuel-air ratio indicator is described, and its functions are explained for a wide variety of applications. It is stated that the instrument has assumed great importance in the aeronautical industry because it makes possible the measurement of the efficiency of an internal-combustion engine to an extent that has not been equalled by any other single instrument. Inventions of early scientists are noted with reference to devices created by them which now are contributing to the effectiveness of the present device. The principal component of the indicator and kindred instruments is stated to be the thermal-conductivity cell, usually employed in multiple in the form of a Wheatstone bridge. The elements of the design of the cell and other inherent properties and processes are outlined.

The theories of thermodynamics necessary to an understanding of the cell are discussed, and the application of the cell to the work of analyzing the exhaust gas from an engine is explained. The mathematical formulas involved in the computation are set forth. The writer shows how the equipment is used in studying the conditions and efficiency of internal-combustion engines through the analysis of the exhaust gases. *Aero Digest*, August 1, 1944, pages 108, 110, 144, 147, 2 illus.

Torque and Thrust Measurements on Small Aircraft Engine Test Stands. J. Liston and C. E. Schaefer. A description is given of a test stand used by Purdue University for the routine instruction of aeronautical and mechanical-engineering students. It is designed to handle air-cooled engines up to 400 or 500 hp. Information is furnished about the means for measuring engine torque, which was incorporated in the original design. This device consists of a reaction torque arm attached to the floating shaft which supports the engine. The torque reaction is taken by two pistons, one of which is attached to a dashpot and the other to a metering valve which allows only sufficient oil to enter to keep the pistons floating near midposition. Air pressure greater than the maximum pressure in the torque cylinders is used to maintain a continuous supply of oil. The torquemeter gauge is a Bourdon tube type of pressure gauge.

The arrangement used for calibration is described and a typical student calibration curve is shown. A modified torquemeter in which metallic bellows filled with oil replace the torque cylinders is also described. *Instruments*, August, 1944, pages 477, 478, 480, 7 illus.

Tools and Equipment

Servicing Motor Starters in Maintenance Shops. R. W. Gemmel and L. E. Markle. Because electrical apparatus is playing an important part in the work of repair shops that are servicing planes, engines, and auxiliaries, information is given about the maintenance of relays and contactors for starting electric motors. A check chart for motor-starter troubles is furnished, detailing the procedure in columns under heads giving the trouble, the cause, and what to do. *Aviation Maintenance*, August, 1944, pages 50–53, 148, 150, 154, 156, 9 illus.

The "Benfold" Bending and Forming Machine. A description is given of a machine developed by The Fairey Aviation Company, Ltd., for producing any desired section by forming and bending in one operation. Typical components that can be manufactured by the machine are mentioned. They include main and nose rib booms, fore and aft wing stiffeners, bulkhead flanges, formers for monocoques, ribs, and floats. Illustrations of the machine in opera-

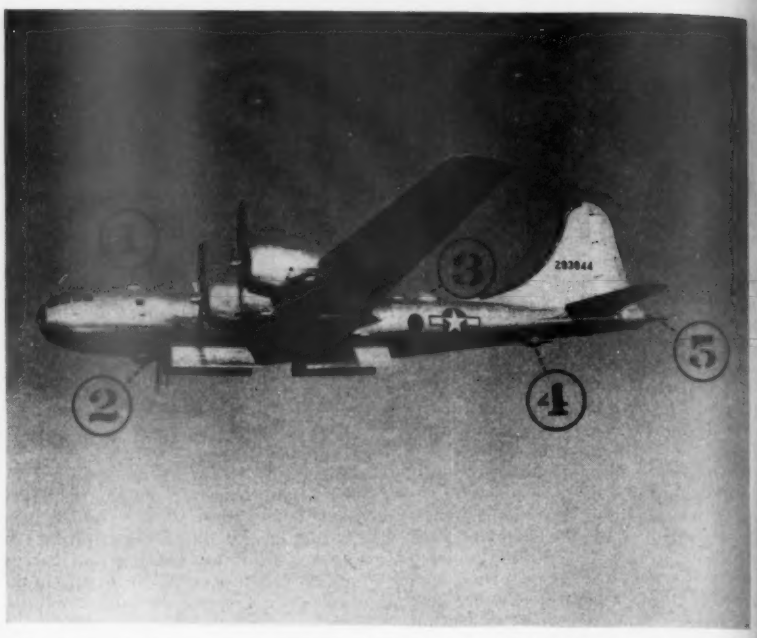
tion are shown. *Engineering*, July 28, 1944, pages 67, 68, 2 illus.

AAF Devises All-Purpose Loosening Tool. The purpose, construction, and operation of a manual tool for removing screws, bolts, and nuts seized because of high-torque installation or corrosion are detailed. Developed by the A.A.F. Air Technical Service Command, as it is now named, this tool also enables the removal of damaged or burred screws. It is said to operate similarly to the spiral-ratchet-action screw driver known as the Yankee, except that the handle is shorter, made of metal, and the rotation is accomplished by a hammer or mallet blow on the handle. The tool consists of a metal barrel, knurled to fit the hand, and a shaft operating within the barrel by means of a helical spline, which cause the shaft to rotate 45° counterclockwise for 1/2-in. axial stroke. The shaft is spring loaded and normally remains extended. It terminates in a 9/32 in.-sq. drive to fit either of two holders accommodating standard bits and bolt sockets. Action of the tool eliminates camming, since the hammer blow forces the bit firmly in the recess of the screw. *Aviation*, August, 1944, page 173, 2 illus.

Training

World CPTP? Fred Hamlin. This is a report of contemplated plans for extending the Inter-American Aviation Training Program to include nationals from countries all over the world. An outline of the proposed setup is given and mention is made of the groups and Governmental agencies that will take an active part in laying the foundations for the new program. Three tentative recommendations are that the program be expanded to provide: (1) for missions by United States aviation experts to foreign countries, (2) for the training of official foreign-government representatives in the United States, and (3) for the training of foreign private citizens in the United States. *Flying*, September, 1944, pages 28, 100, 102, 1 illus.

Robot Engine-Tutor Talks Back. Robert I. Colin. This article tells of a training device that is used at the A.A.F. Technical School of Yale University. A mock-up panel of "typical" aircraft engine starting and ignition systems, the device aids in teaching students the construction and operation of these systems. It also helps to impress upon them two important precautions in connection with the starting of an aircraft engine: (1) never to touch the propeller without first ascertaining that the ignition switch is in the off position; and (2) always to turn the propeller of a radial or inverted engine several times by hand (with the ignition off) before using the electric starter, to make sure that there is no obstruction caused by an accumulation of oil in the lower cylinders. *Aviation*, August, 1944, pages 195, 270–273, 2 illus.



The five multiple-gun, remote-controlled turrets of the Boeing B-29 Superfortress give it one of the most highly developed defensive armament systems of any airplane. The system is completely electrical and makes possible an instantaneous and heavy concentration of fire power on any target approaching the airplane from any direction. These turrets have been touched out from previously published B-29 pictures for reasons of security. No. 1 is the upper-forward turret; 2, lower-forward turret; 3, upper-rear turret; 4, lower-rear turret; 5, tail mount. Each has two 0.50-cal. machine guns; in addition, the tail mount has a 20-mm. cannon.

Search. H. J. Harrison. This article deals with the importance of night-vision training for aircraft gunners. Stressing the special need of aircraft gunners for visual acuity at night, the writer explains the structure of the eye and how night conditions affect its functioning. He describes methods by which night vision can be improved. The Lateral Method of searching for objects is outlined and information is given about the Lamplough Trainer, which the writer considers the most useful piece of night-vision training equipment from the gunner's point of view. Part of the article is devoted to dark-adaptation methods. *The Aeroplane*, July 7, 1944, pages 17–19, 3 illus.

Air Age Education Number. All of the articles in the June issue of the magazine *Education* refer to various fields of the aeronautical sciences, with particular reference to the functions of education in connection with those sciences. The titles of the articles and the writers are as follows: "Education for the Air Age," by N. L. Engelhardt, Jr.; "Air Lanes and Education," by William E. Givens; "Education Faces the Air-Age," by Richard T. Parsons; "The Function of a State Department of Education in the Development of Aviation Education," by G. Franklin Stover; "Flight and Mechanic Training in Motorless Planes for Secondary Schools," by Emerson Neuthardt; "A Commercial Point of View," by W. A. Wheatley; "Air Youth," by William R. Enyart; "Wing Scouting," by Anne L. New; "The Contribution of the Library"; "The Place of Professional Societies in Post-War Education," by Lester D. Gardner; "Teachers Have Many Questions Answered at Aviation Operations Institute," by Harry S. Ganders. *Education*, June, 1944, pages 583–631.

Warfare

Countering the Air Torpedo. Measures that Britain is taking to combat robot bombs are recorded. Four phases of the defensive action are discussed: bombing attacks on robot-launching sites, attacks by fighter planes on the projectiles in flight, antiaircraft fire, and balloon barrages. *Flight*, July 13, 1944, pages 42–44, 3 illus.

Our Friends the Polish Airmen. Henry Baerlein. This is a brief outline review of the record of Polish airmen fighting from Britain. Figures are given on the number of German planes they have destroyed, number of bombing raids in which they have participated, number of service decorations they have won, etc., up to May 1, 1944. Included in the article are some brief notes on the first Polish squadrons to be formed in Britain, the training that was given to flying personnel in Poland before the war, and the planes that were used by the Polish Air Force before their country was taken over by the Germans. *The Aeroplane*, July 21, 1944, pages 72, 73, 4 illus.

In 1919, despite the turmoil of demobilization and reconversion, Wright Aeronautical, a direct descendant of the original Wright Company, began specialized development of aircraft engines. In the next 25 years, Wright research became a fountain-head of development which gave the world the air-cooled radial engine — the engine which brought world air commerce into being and gives power to Allied Air Forces today. Now problems of re-adjustment again loom ahead. But as in 1919, Wright stands ready, with new skill and facilities born of war, to provide power leadership in the Air Age of tomorrow.

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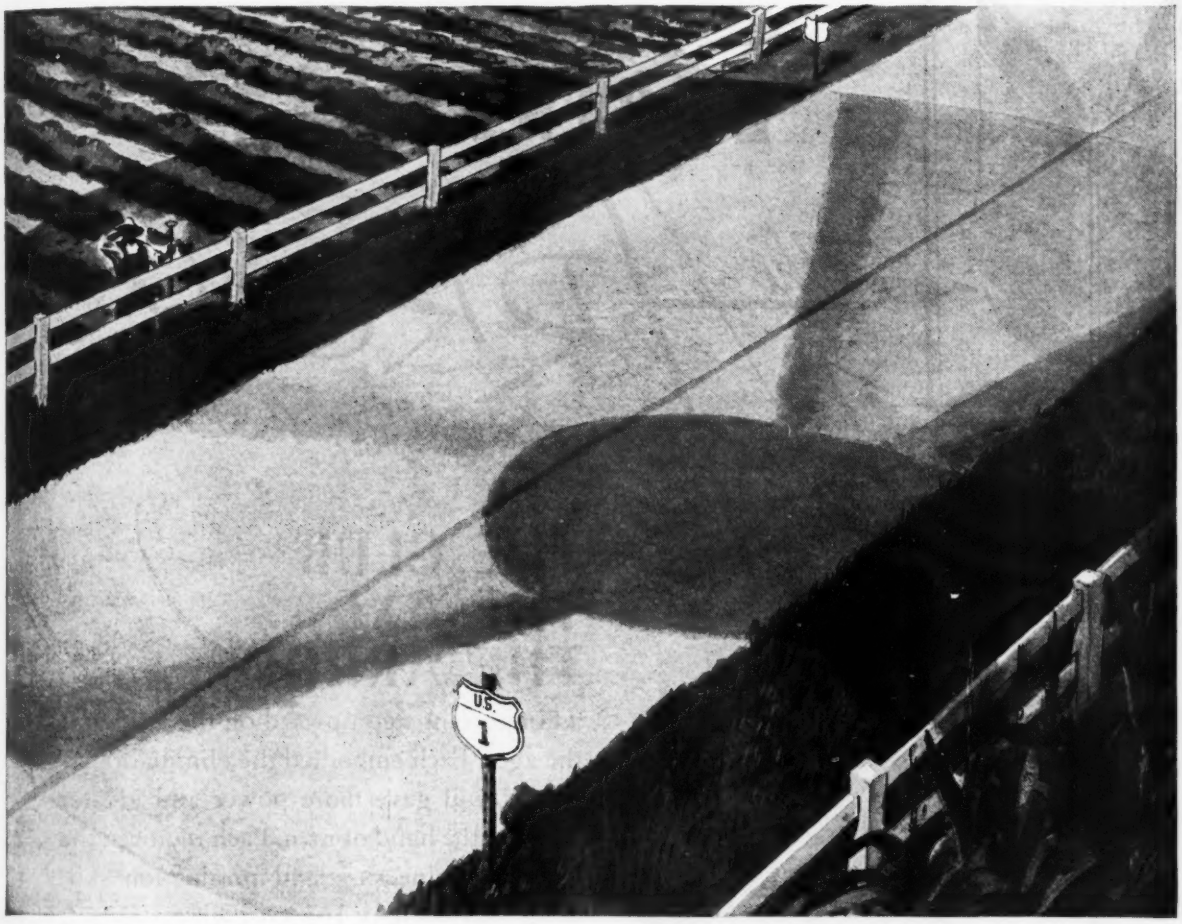

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... each was an important step upward on the ladder of the ages. Each embodied the elimination of weight and gave more power and greater range to the hand of man. Each required the highest engineering and production skill of its day. Today the Guiberson Diesel, backed by more than 25 years of precision production of oil tools and more than 15 years of engineering and production of diesel engines, is the fleet arrow of tomorrow's transportation on sea, on land and in the air. It is the light weight power plant that is safer, more economical and more efficient.

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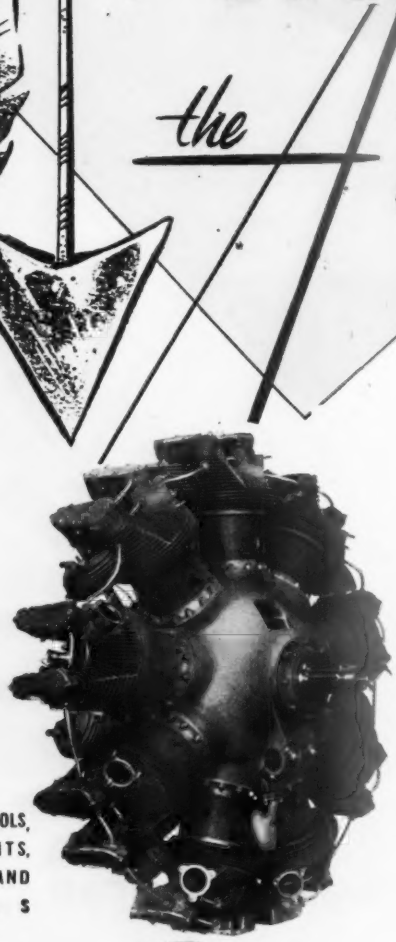
ENGINEERING the ARROW



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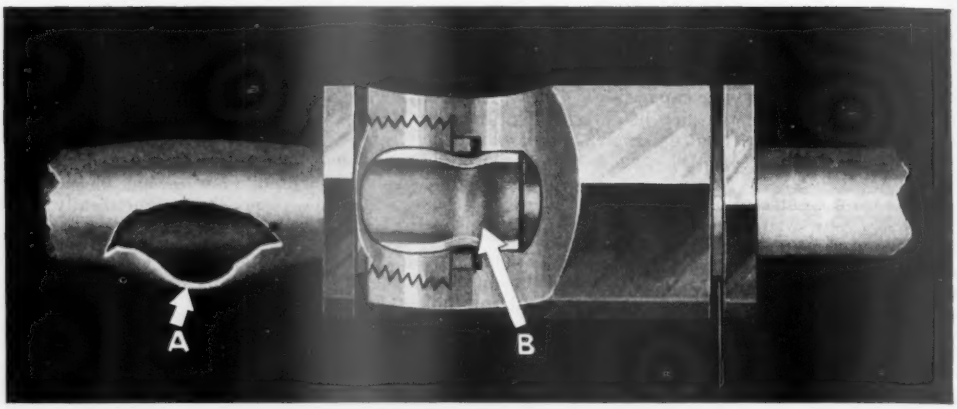
"Another Martin First!"



Cut-away view of new Martin rigid hydraulic tube connection. Arrow "A" indicated point at which tubing gave way under pressure of 6,200 p.s.i. while connection held firm without leakage. Arrow "B" points to cut-away section and bead put in tubing by rubber ring when gland nut has been tightened.

New Martin Hydraulic Tube Connection

Withstands constant vibration, higher pressures without leakage, failure, or pressure loss

Failure or leakage of hydraulic tube connections, long a stumbling block in the utilization of high-pressure hydraulic equipment, has now to a great extent been overcome, thanks to a new Martin rigid hydraulic tube connection.

Simple, Foolproof With the Martin connection, the tube is beaded by an axial thrust against a rubber seal ring which is completely confined. The thrust is accomplished by turning up on a gland nut. Thus the present flaring operation, which is so often the source of leakage or failure, is eliminated, and steel or hard alloy tubing of higher strength than the usual 52SO-soft may be used. Moreover, the connection is foolproof, being so designed that after proper tube bead has been obtained the gland nut bottoms in the gland and further crushing of the tube is impossible. The elimination of flaring and external beading makes gland unit readily removable.

Tight, Leakproof When the new Martin connection is in use, the rubber ring is constantly exerting an outward force on the gland nut, thus locking the threads; while the pressure of the expansion ring forces the rubber to completely seal the tube against leakage.

This new fitting may be installed quickly and easily as a repair for a broken tube, or as an original permanent installation. Fittings may be standard and have varying width compression rings for varying pressure requirements. All parts may be used over again, excepting the rubber ring which in some instances may have to be replaced. The simple design of this fitting will make it easy to fabricate in large quantities and at a minimum cost. Martin engineers predict wide-spread varied uses for this connection throughout the aircraft and other industries. Interested companies write:

THE GLENN L. MARTIN CO. BALTIMORE 3, MD.
THE GLENN L. MARTIN-NEBRASKA COMPANY—OMAHA

TEST RESULTS

The following tests have been made on the new Martin rigid hydraulic tube connection:

(1) Torque required to install a 3/8 fitting.
Aluminum—200 inch pounds.
Steel —900 inch pounds.

(2) Pressure test on aluminum tube inst. with one end of assembly capped:
3/8 dia. tube x 035 wall—6,200 p.s.i.
5/8 dia. tube x 049 wall—5,000 p.s.i.

(3) 3/8 steel and alum. tubing assembled in a double fitting and vibrated for 25 hours under 1500 p.s.i. pressure and no evidence of leakage.

(4) Mechanical tension test:
3/8 steel tubing 1000#
5/8 alum. tubing 400#

(5) Pressure loss due to restriction in tube is negligible due to smooth contour of restricted area.

Martin AIRCRAFT

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Army Air Forces

The Men of the B-29s. Brig. Gen. Kenneth B. Wolfe. An account of how the 58th Bombardment Wing (which later became the 20th Bomber Command) committed the B-29 to its first combat operations is given by the general in charge of the activities. The record deals with the role played by A.A.F. officers and men in supervising and expediting production, flight-testing experimental planes and production aircraft, effecting modifications while prescribing changes in equipment for later models, determining the flight characteristics and limitations of the Superfortress, establishing tactics best suited for combat, training air and ground crews, and preparing squadrons for combat service overseas. It reviews the story of the 20th Bomber Command from the inception of the 58th Bombardment Wing in June, 1943, to the bombing of Yawata in June, 1944. *Air Force*, September, 1944.

New Helicopter Under Development. The Platt-LePage helicopter XR-1 is being tested by engineers of the Air Technical Service Command. The XR-1 weighs 4,800 lbs. Its fuselage resembles a normal airplane fuselage without engine or propeller. The tail is of conventional design, while the engine is a 450-hp. Pratt & Whitney, located approximately in the middle of the fuselage and enclosed. Two cockpits in tandem occupy the forward part of the aircraft and have sliding canopies like fighter planes. Compartment bottoms are of transparent plastic, allowing clear vision approaching the vertical and adding to the craft's usefulness in observation.

Extending from each side of the fuselage, just back of the cockpit, are two streamlined pylons giving the impression of wings. Single rotors 30 ft., 6 in. in diameter rotate in opposite directions at the ends of the pylons, the counter-rotation being intended to overcome the effect of torque. The landing gear is conventional. *Air Technical Service Command.*

Pacing the Attack. Major Arthur Gordon. The employment of tactical air power in the Allied drive from the Normandy peninsula toward Paris is reviewed. The reasons for and the results of using heavy bombers in support of the ground troops are outlined. While stressing the effectiveness of employing air power for tactical purposes during this campaign, the article shows that the Allies had sufficient strength to maintain their strategic bombing also. *Air Force*, September, 1944.

Life Vest for Stranded Fliers Holds Hunting Gear. New emergency life vests for combat pilots are intended to overcome objections to earlier designs and provide airmen with all the essentials necessary for survival under emergency conditions. The new equipment weighs only 10 lbs., including a 0.45-cal. pistol and 20 rounds of ammunition. The vest has tie strings in the back and one size can be adjusted to fit any man.

The kit contains the necessary equipment to aid the stranded pilot to obtain food and to signal rescue parties. It also provides rations sufficient for three weeks. Fish lines; knives; sun goggles; mosquito netting; cooking equipment; fire-starting kit; first aid materials and medicines; leather and woolen gloves; and a manual on desert, arctic and ocean survival all go into this bundle, which is worn under the parachute. One of the unusual provisions is the loading of bird shot into 0.45-cal. pistol cartridges instead of lead bullets. This enables the stranded pilot to shoot fowl and other game. *Air Technical Service Command.*

GI Airline for the Wounded. E. T. Wallace. This article is concerned with the final stage in the air evacuation of wounded American soldiers from combat areas. It tells how wounded men flown from overseas are landed at nine air debarkation hospitals in the United States and from those points are transported by air to hospitals in the vicinity of their own home towns. The operations described are missions of the Air Transport Command. *Air Force*, September, 1944.

Organization Chart Army Air Forces. A double-page colored chart gives the organization and personnel of the Army Air Forces as of August 10, 1944. The chart lists the various sections and the names of the Army officers in charge of each office or division. *Air Force*, September, 1944.

Photograph Courtesy A.A.F. Air Technical Service Command

A recently developed 27-ft. plywood air-borne lifeboat is fastened to the fuselage of a B-17 by cables attached to conventional bomb shackles. Dropped by parachute to stranded airmen, the lifeboat carries food, clothing, medical supplies, radio, and other essentials necessary for a 1,500-mile voyage.

Ranging far out over enemy waters, bombing convoys, getting valuable reconnaissance information, countless Navy patrol bombers, finished with Berry Brothers' materials, are dramatically shortening Axis resistance. ¶ When the war is over, counterparts of these same famous planes, finished with the same famous finishes, will through world-wide commercial aviation, help reunite a world which war has torn apart.

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Pointie Talkie is a booklet of 61 pages containing a collection of words and phrases commonly needed for asking directions and securing such other information as would be required by an American soldier or airman in China.

Questions are listed in English and Chinese characters in parallel columns on each page. The American can select the question he wishes to ask and then point to the corresponding representation in Chinese. On the facing page, with corresponding numbers, are printed appropriate answers in Chinese characters, alongside of which are the translations into English. The booklet is divided into sections referring to various contingencies, such as finding an interpreter, courtesy phrases, questions about food and drink, comfort and lodgings, servicing an airplane, and similar situations. Tables of figures and place names are also included, together with instructions in the use of the booklet. For sale by the Superintendent of Documents, Washington, $0.15.

National Advisory Committee for Aeronautics

Methods of Stress Calculation in Rotating Disks, by S. Tumarkin. (Translation of Report No. 262 of the Central Aero-Hydrodynamical Institute, Moscow, 1936.) This paper describes methods of computing the stresses in discs of a given profile, as well as methods of choosing the disc profiles for a given stress distribution for turbines, turboblowers, etc. A new method of integrating the differential equations of Stodola leads to a simplification of the computation for discs of hyperbolic profile. It was found possible to apply to the equations a method analogous to the methods of Donath and Yanovsky for discs of constant thickness, the sum and difference of the stresses $S = \tau + \sigma$, $D = \tau - \sigma$ being replaced in the equations by the expressions $S = m\sigma + \tau$, $D = n\sigma + r$ where m and n are constants.

For the first time, apparently, the problem of the choice of profile for discs carrying lateral blades is investigated. In contrast to the case considered by Holzer of discs with blades attached at the rim, it is impossible in this case to assume arbitrarily the curve of radial stresses and the edge thickness of a disc. In a number of cases infinitely diverging and other unsuitable profiles occur.

The dependence of the profile shape on the assumed stresses is investigated. An example of the improvement of a typical disc profile is analyzed, showing considerable gain in material on approaching the condition of uniform strength. The method of Holzer, for discs with blades attached at the rim, is considerably simplified by dispensing with the necessity for graphical or mechanical integration. The possible limit of tangential stresses for a given curve of radial stresses, a factor of much value in selecting a profile, is considered. *N.A.C.A. T.M. No. 1064*, September, 1944.

DVL Angular Velocity Recorder, by Wolfgang Liebe. (Translation of "Dreiachsen-Winkelgeschwindigkeitsschreiber der DVL," *Luftwissen*, 1938.) In many studies, especially of nonstationary flight motion, it is necessary to determine the angular velocities at which the airplane rotates about its various axes. The three-component recorder described in this paper has been designed to serve this purpose.

If the angular velocity for one flight attitude is known, other important quantities can be derived from its time rate of change, such as the angular acceleration by differentiations, or—by integration—the angles of position of the airplane, that is, the angles formed by the airplane axes with the axis direction presented at the instant of the beginning of the motion that is to be investigated. *N.A.C.A. T.M. No. 1065*, August, 1944.

Determination of the Actual Contact Surface of a Brush Contact, by Ragnar Holm. (Translation of "Eine Bestimmung der wirklichen Berührungsfläche eines Bürstenkontaktes," *Wissenschaftliche Veröffentlichungen aus den Siemens-Werken*, 1938.) The number of partial contact surfaces of a brush-ring contact is measured by means of a statistical method. The particular brush is fitted with wicks, that is, insulated and cemented cylinders of brush material, terminating in the brush surface. The number of partial contact surfaces can be computed from the length of the rest periods in which such wicks remain without current. Resistance measurements enable the determination of the size of the contact surfaces. The pressure in the actual contact surface of a recently bedded brush is found to be not much lower than the Brinell hardness of the brush. *N.A.C.A. T.M. No 1071*, August, 1944.

The Surface Structure of Ground Metal Crystals, by W. Boas and E. Schmid. (Translation of "Über die Struktur der Oberfläche geschliffener Metallkristalle," *Naturwissenschaften*, 1932.) Report of a systematic investigation of the changes produced on metallic surfaces as a result of grinding and polishing. The roentgenographic method followed in the investigation is described. The method consists of the recording of Laue-reflection diagrams with X-rays of specially long wave lengths, that is, X-rays suitable for the study of the structure of thin sections. If, in addition, diffractions lie at great angles of deviation for the characteristic radiation of the employed anticathode, the same arrangement makes it possible to detect fine-grained layers or such with ordered texture by the appearance of Debye-Scherrer concentric rings or layer lines. In this manner the grinding effect can be followed by a series of records after etching with a varying degree of severity.

The metals used in the present study included aluminum, copper, tin, cadmium, and antimony. The crystals appeared in form of cylindrical bars of about 4 mm. diameter. First, a Laue-reflection diagram of each of the explored crystals was taken, and the crystal then ground as nearly as possible perpendicular to the employed ray direction. The little bars were embedded in Picein wax and ground about 0.5 mm. parallel to the longitudinal axis on a rotating disc (emery paper No. 2, then reground with No. 1G), and then polished with alumina No. 2 or 1 on a slowly rotating disc. The X-rays were obtained from commercial tubes having stated properties. After etching, the specimens were carefully returned to the same position, with the cut surface perpendicular to the incident ray, before the tube.

It is concluded that the grinding and polishing of metal crystals results in the formation of two layers in the metal: a fine crystalline thin surface layer and a deformed transition layer about 10 times as thick, which establishes the connection with the undamaged base crystal. Results are tabulated, and photographs of the specimens are appended. *N.A.C.A. T.M. No. 1072*, August, 1944.

The Frictional Force with Respect to the Actual Contact Surface, by Ragnar Holm. (Translation of "Über die auf die wirkliche Berührungsfläche bezogene Reibungskraft," *Wissenschaftliche Veröffentlichungen aus den Siemens-Werken*, 1938.) Hardy's statement that the frictional force is largely adhesion and, to a lesser extent, deformation energy is proved by a simple experiment. The actual contact surface of sliding contacts and hence the friction per unit of contact surface was determined in several cases. It was found, for contacts in normal atmosphere, to be about one-third to one-half as high as the macroscopic tearing strength of the softest contact link, while contacts annealed in vacuum and then tested disclosed frictional forces that are greater than the macroscopic strength. *N.A.C.A. T.M. No. 1074*, August, 1944.

Bureau of Aeronautics

Paint Stripping and Cleaning Operations—Compounds for Aircraft Uses. A revised wall chart sets forth detailed instructions for the preparation of aircraft surfaces and the paint-stripping and cleaning compounds specified for this type of work. Sections refer to washing of aircraft surfaces; hand stripping of paint from large surfaces; tank paint stripping of aircraft parts; carbon removal and engine-overhaul cleaning; cleaning of aircraft parts prior to refinishing or anodizing; cleaning and polishing of transparent plastic sheet. *Navaer, Engineering Equipment and Materials No. 2*, January, 1944.

Ice Formation on Aircraft. A booklet of 40 pages, constituting Number One of the Aerology Series, contains an explanation of the circumstances under which ice forms on aircraft and of the steps to be taken in meeting that situation. In addition to specific

instructions for combating ice formations on various parts of the airplane, the booklet gives general instructions for flying during icing conditions. *Bureau of Aeronautics, U.S. Navy Department*, Washington, D.C., $0.10.

Bureau of Foreign and Domestic Commerce

Air Cargo Potentials between the United States and Brazil. A pamphlet of 32 pages is one of a series of releases dealing with the potential market for air transportation between the United States and various Latin American countries. The series is intended to attempt a solution of the problem of increasing the flow of trade between the republics of the Western Hemisphere, as well as to accelerate the rate of trade in those commodities where speed is essential.

The basic data contained in the series will not only be of assistance to exporters and importers in helping them to determine which products can be most advantageously shipped by air, but will also be of aid in the determination of the volume and types of aircraft necessary to handle airborne cargoes adequately.

A similar booklet has been issued under the title of *Air Cargo Potentials between the United States and Peru. Inquiry Reference Service, U.S. Department of Commerce.*

Civil Aeronautics Administration

Air Traffic Rules as Amended August 1, 1943. Manual 60 has been issued as a supplement to Part 60 of the Civil Air Regulations. The issuance of Part 60 in simplified form makes it no longer necessary to publish a summary of the miscellaneous air traffic rules.

The emergency regulations, as contained in Section 60.95 of the Civil Air Regulations, are not covered in this manual. Consequently, this manual deals only with those sections of Part 60 which pertain directly to air traffic control.

It outlines, in easily understandable form, the procedures and phraseologies for both airport and airway traffic control. While they are not regulations in themselves, they have been set up as recommended practices that will provide for safety in the operation of aircraft.

The manual is divided into two sections, the first relating to airport traffic control and the second to airway traffic control. The first section has chapters dealing with taxiing, landing, take-off, and traffic patterns, as well as light-signal procedures and radiotelephone communication procedure and technique. The second section includes contact-flight rules and instrument-flight rules. An appendix contains a glossary. *Civil Aeronautics Manual 60.* For sale by the Superintendent of Documents, Washington, D.C., $0.15.

Airport Drainage Design Information. This publication supplements the information contained in Chapter V of the *Airport Design Information Bulletin* dated May 8, 1941, and is intended to provide persons charged with the responsibility of preparing recommendations and designs of airport drainage with basic information and suggested methods of economical drainage treatment. At the end of the booklet there are several reproductions of designs for drainage systems for different parts of an airport.

Grid System for Air-Marking. Based upon its original air-marking program begun in 1935, as well as upon a recent intensive 3-year study, the C.A.A. has completed its plans for having every city, town, and village in the country marked so that its exact location may be understandable to the pilot. About 100,000 air markers or air guides will be required to cover the continental United States. The Administration has already started marking the roofs of its range-station and communications-station buildings in accordance with the new system.

During the 3-year study, the C.A.A. has examined a large number of suggested systems. Interviews with hundreds of pilots, flight observations of various kinds of markers, and conferences with state aviation officials, have resulted in adoption of the grid system, which will hereafter be standard.

The system calls for the lettering of the name of the town on a roof or wall in letters from 10 to 20 ft. high, also the latitude and longitude of the place, separated by an arrow pointing to true north. In addition, special symbols will be used to point the direction of, and give the mileage to, the nearest air park, airport, or other landing area. These four items of information: the name of the town, its latitude and longitude, the indication of true north, and the distance to the nearest safe landing area, comprise a complete air guide for the pilot.

Latitude and longitude figures are given in degrees and tenths, and reference to standard flying maps will make it possible for any flier to pinpoint his position positively. Inasmuch as in the United States all latitude is north and all longitude is west, the letters N. and W. are not included. The latitude figure is always first in normal reading position, and, in the United States, the latitude figure is always the smaller.

If there is a paved airport nearby, the name of the city at which it is located appears within the outline of a broad arrow pointing toward the city named. At the point of this arrow is a figure indicating the distance in miles to the airport. If there is an air park nearby, the symbol is a circle with a short arrow, with the distance in miles at the point of the arrow.

Air guides may also be placed on highways; on mountainsides where the letters and arrows will be formed of

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ARMY E NAVY

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REYNOLDS ALUMINUM:

To cool America's sky horses—Aluminum takes strange shapes

LOOK, for a minute, inside the huge, blocks-long Plant No. 14 of Reynolds Aluminum . . .

Before you spreads out a strange and fascinating sight . . . sheets of shining aluminum are being stamped by batteries of huge machines into queer, exciting shapes . . . some that remind you of unusual-looking pudding molds . . . other shapes that look like tomorrow's kitchen utensils.

These strange shapes of aluminum are known to airplane technicians as *baffles*—and they are vitally essential to every air-cooled warplane engine. Fitted around the engine's cylinders, they are carefully designed to catch the flow of air . . . to circulate it evenly around every cylinder.

It was in answer to an SOS call from the engine-makers that Reynolds Aluminum went into production of baffles. "We've hit a bottle-neck," said the manufacturers. "You people have broken other bottle-necks in the industry—can you turn out baffles for us?"

Just to set up a plant of the size needed was a monumental job. It meant precision sheet metal work to extremely close tolerances. Stamping machines had to be assembled from the four corners of the country; heat-treating equipment had to be built; a special conveyor system designed. But five months after that SOS was received, the Reynolds plant was put into operation. Already the number of baffles turned out for America's warplane engines runs into the millions.

A PROMISE FOR TOMORROW

After the war, the giant machines in this huge plant can quickly be turned to producing better, more efficient pots and pans than American women have ever known. But for the present, Reynolds Aluminum is concentrating on "the future that counts most"—that time between today and the day of complete victory for our forces.

REYNOLDS METALS CO.
Aluminum and Parts Div., Louisville 1, Ky.

REYNOLDS ALUMINUM BAFFLES fitted around the cylinders of the powerful Pratt & Whitney engine on these Grumman F6F Hellcat planes catch the air that keeps the engine cool, efficiently operating.

THE MIRACLE of Reynolds Aluminum is portrayed in unforgettable fashion in the new sound movie, "A Recital of Faith." It shows how Reynolds scrapped all precedent and created a huge new source of aluminum, to speed Victory and provide an abundance of low-cost alloys for post-war uses. For a private showing to interested executives in your organization, write Reynolds Metals Co.

crushed rock; on lawns, road intersections and cloverleafs, with small shrubs forming the letters; and in desert areas, where letters made of metal strips with enamel coating will be mounted on posts a few feet above the ground. Markers on some roofs in towns may be illuminated so as to be visible at night. In northern sections, where snow would obscure markers on roofs and highways, air guides can be painted on the sides of silos, grain elevators, and large buildings Chrome yellow and black, international orange and white, are preferred colors for high visibility.

The C.A.A. Airways Engineering Division has issued a complete manual for assistance in installing the guides. It has also designed a set of three simple templates made of plywood by means of which unskilled laborers can lay out any letter or any figure from 10 to 20 ft. in height. The manual contains a table showing the proper distances between various letters and figures. The manual and the template plan will be made available to anyone interested.

Altitude and Its Effect Upon Airplane Performance. The brief and rather elementary discussion of the subject that is contained in this report was undertaken primarily to provide information for inclusion in a publication addressed to private pilots. Upon its completion, however, it was concluded that considerable abridgment would be necessary to serve the purpose originally intended, whereas the entire paper was of sufficient value to warrant its separate publication.

The report is divided into sections referring to mechanical properties of the atmosphere, the standard atmosphere, the altimeter, the effect of altitude upon performance. A graph contains data showing the relationship of power to speed in climbing flight, and tables give figures for the take-off ground run, the rate of climb, and the stalling speed. *Flight Engineering Report No. 13, Safety Regulation Release No. 164,* July, 1944.

Portable Flutter Recorder. A portable flight-vibration recorder, easily and quickly installed, for studying airplane vibration and flutter during flight has been developed by the C.A.A. and is now available commercially.

The self-contained instrument is light enough to be held on the lap of an observer and can be installed and put into use within a half day. It was developed by the Aircraft Development Section of the Technical Development Division and is being manufactured by the Brown Instrument Company, of Philadelphia.

The new recorder does not replace the more elaborate and complicated equipment already in use for studying flutter in airplanes. Its chief value is in its small size and ease of installation, making possible rapid re-examination of doubtful studies and many additional tests in difficult cases. By using the

new recorder, velocity or accelerometer type pickups can be placed at many places about the structure, and two of these can be operated simultaneously. By using a selector switch, many locations about the plane can be studied in the same flight. The recorder contains its own batteries, amplifier, electronic switch, cathode-ray tube, and a means for observing the record on a screen. There is also a camera to photograph the oscillograph record.

The machine is useful for studying vibration anywhere about the plane, such as in motor mounts, cowling, and small accessories, where its ease of installation as a special-purpose instrument is important. Development of the new recorder was begun by the C.A.A. in cooperation with the Brown company in 1940 to make possible accurate measurement of the response of the entire aircraft structure to pulsating and vibratory forces.

Development of the Ultra-High-Frequency Radio Range. Part I of a report on the development of the ultra-high-frequency aural radio range describes a series of aural radio-range experiments conducted at frequencies of 63 and 125 megacycles. The results of numerous ground and flight tests using vertical and horizontal antennas are discussed, with particular reference to the radio frequency, multiple courses, cone-of-silence characteristics, polarization and reflection effects, noise, atmospherics, distance range, ionosphere reflections, and aircraft antennas. The report traces the progression of development from vertical polarization to horizontal polarization using crossed dipoles to the finally adopted horizontally polarized array using horizontal loops which have substantially pure polarization. It is shown that, through the use of new developments made available by the rapidly progressing art of applying ultra-high frequencies to the radio range problem, a radio range operating on 125 megacycles and using pure horizontal polarization is superior to any of the other ultra-high-frequency facilities previously developed. *Technical Development Report No. 42,* June, 1944.

Department of Agriculture

Progress Reports of the Forest Products Laboratory. Additional reports in the series have been made available, giving information concerning wood materials and their uses in aircraft construction. The reports are part of a series issued in cooperation with the Army-Navy-Civil Committee on Aircraft Design Criteria under the supervision of the Aeronautical Board.

No. 1508 is titled "Buckling of Thin, Curved, Plywood Plates in Axial Compression." No. 1510 refers to the "Effect of Elliptic or Circular Holes on the Stress Distribution in Plates of Wood or Plywood Considered as Orthotropic Materials." No. 1511 is a study of the "Strength and Related Properties of Balsa and Quipo Woods."

Included is a report titled "The Use of Wood for Aircraft in the United Kingdom," constituting No. 1540 in the series. It gives details of the information obtained by a group of representatives of the Forest Products Laboratory who visited England during August–October, 1943.

Forest Pathology Special Release No. 21 is titled "The Significance of the Discolorations in Aircraft Lumber: Sitka Spruce" and gives the results of a survey and tests made on specimens of the wood to determine the significance of discolorations. *U.S. Department of Agriculture, Forest Service, Forest Products Laboratory,* in cooperation with the University of Wisconsin, Madison, Wis.

Department of Labor

British Policies and Methods in Employing Women in Wartime, by Janet M. Hooks, is a report describing the step-by-step procedure under the British Government program in the employment of women in the war emergency. Its chapters discuss the various problems arising from the shortage of man power and how the people of Great Britain utilized the services of women in war production. *Bulletin of the Women's Bureau, No. 200.* For sale by the Superintendent of Documents, Washington, D.C., $0.10.

Department of State

Treaties in Force. A 275-page paper-bound book contains a bibliography of treaties and other international acts of the United States in force as of December 31, 1941. The treaties are classified under the following headings: promotion of peace; political; humanitarian; economic; and miscellaneous. Treaties, agreements, conventions, and other documents referring to aeronautical matters are included in the list. *Department of State Publication No. 2103.* For sale by the Superintendent of Documents, Washington, D.C., $0.40.

National Bureau of Standards

Table of Coefficients for Inverse Interpolation with Advancing Differences. Herbert E. Salzer. This compilation of tables, reprinted from

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Keeping posted high in the air is one secret of successful flying. The ground keeps track of the plane. The plane knows the weather, the course, and what it's like at the field.

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the *Journal of Mathematics and Physics*, contains the coefficients of fourth, fifth, and sixth order terms. It may be regarded as a companion table to one published in a previous article in December, 1943, titled "Table of Coefficients for Inverse Interpolation with Central Differences."

There are many occasions in the performance of inverse interpolation where only advancing or backward differences are available. Examples occur when the inverse interpolation is at the beginning or end of a table, also when only a few values are tabulated altogether (which often occurs in finding the zeros of involved expressions). Thus, in a strict sense, because this table can be used everywhere it is stated to be even more fundamental than the preceding one which employs central differences.

A condensed one-page table of coefficients of the fourth, fifth, and sixth order terms, at intervals of 0.1, is also given for the sake of convenience, since there are many cases where a larger table is unnecessary. *Mathematical Tables Project, National Bureau of Standards*, Washington, D.C., $0.50.

Navy Department

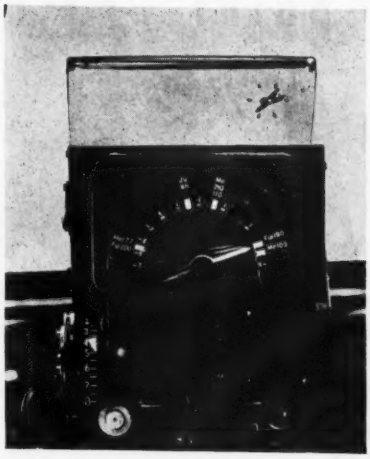
Return to Guam and **Invasion—Nazi Version** are two entirely new combat films, now available for exclusive showing to war workers.

Invasion—Nazi Version shows the storming of the beaches of Europe by Allied armies, as seen through German cameras. These films, captured from the enemy in the swift-moving onslaught of the Allies, illustrate the high cost in men and material exacted by the invasion. High lights of the film are scenes in which captured American and English paratroopers are shown being marched to prison camps behind Nazi lines, and those depicting the duel of gunfire between German shore batteries and Allied battleships offshore, firing at almost point-blank range. The film, which was obtained by the Office of Strategic Services, runs 18 min.

Return to Guam is a 16-min. résumé of the amphibious assault that brought U.S. forces back to the soil of Guam for the first time since Japan seized this former American possession. First, the 17-day "softening up" process is shown, with all the Navy's guns from the 16-in. main batteries down to the 40-mm. and 20-mm. guns. The climax is the action showing Marines "hitting the beach" in the retaking of this strategic island. *Industrial Incentive Division, Navy Department.*

Office of War Mobilization

Report on Surplus Aircraft Disposal. This report, submitted by the Surplus Aircraft Advisory Subcommittee, contains a review of the activities of the Subcommittee and its recommendations for handling the problem of the disposal of surplus aircraft.



British Official Photograph
The British Mark 2-D gyro gun sight.

Following an explanation of the method of approach, the report is divided into two parts. The first part outlines the basic policies and the different phases of the problem, the second gives specific recommendations concerning tactical, transport, and personal aircraft, aircraft equipment and components, and the unabsorbed surplus. *Surplus War Property Administration.*

War Department

Contractors Guide. Suggestions are given for the procedure necessary in connection with the termination of war material contracts negotiated by the different sections of the War Department. The first part refers to fixed-price supply contracts, the second part deals with the steps leading to settlement, and the third part contains reproductions of new forms recently approved by the War Department for use in submitting claims and taking other appropriate action. *War Department Pamphlet No. 34-2.*

Accounting for Government Property Furnished Under Fixed Price Contracts. The purpose of this manual is to provide a system of accounting for Government property furnished to contractors under War Department fixed-price contracts. The manual is applicable to all Government property furnished to fixed-price prime contractors and their subcontractors under existing and future War Department contracts, except as provided. The procedures set forth in this manual apply also to property leased to contractors for use on Government work. The manual is arranged in loose-leaf fashion so that changes can be inserted. *TM 14-911*, June, 1944. For sale by the Superintendent of Documents, Washington, D.C., $0.10.

War Production Board

Facts for the Industry—Metal Products, Part I. This pamphlet contains tabulated statistics referring to the value of shipments and unfilled orders for metal products for the first quarter of 1944, classified according to product, prewar industry, and claimant agency. It is the first of a series of statistical reports on the operation of the metal-products industries. The second and third parts will give data about uses of inventories and unemployment aspects of this industry. The data are based on reports of planned operations submitted to the War Production Board, with certain exceptions, and were compiled jointly with the Bureau of the Census. *Series 50-3-1, War Production Board, Industry and Facilities Branch.*

British Air Commission

Spitfire XIV. Limited information has been released about the Spitfire XIV single-seater fighter-bomber. It is a low-wing monoplane, with single fin and rudder and elliptical wings, designed by the Supermarine Works of Vickers Armstrongs Ltd. The dimensions are: span, 36 ft. 10 in.; length, 32 ft. 7 3/4 in.; height (tail up, one blade vertical), 11 ft. 1 1/2 in.; wing area, 248.5 sq.ft.; weight, about 8,000 lbs.

The plane is powered by a single Rolls-Royce Griffon engine of over 2,000 hp., having 12 cylinders set in V at a 60° angle. The cylinder dimensions are: 6 in. bore and 6.6 in. stroke, compression ratio is 6:1, and the capacity is 37 liters. The ratio of the power to the weight is less than 1 lb. per hp.

The following features of the engine are noted: the camshaft and ignition drives are arranged from the propeller wheel at the front of the crankshaft; dual ignition is provided in one magneto unit; propeller and ignition control are interconnected; an automatic change for the two-speed supercharger is arranged to prevent the use of high gear at sea level and to change the gear at the altitude where maximum performance will be obtained at the prevailing airspeed; an improved system of fuel-feed control is used to insure correct carburetion during fighting aerobatics; electrical or cartridge starting is optional.

The engine operates a Rotol five-bladed, constant-speed, variable-pitch propeller for which the reduction-gear ratio is either 0.51:1 or 0.45:1.

Performance details are restricted except that it is stated to be faster than any other Spitfire in service and that its ceiling is over 40,000 ft.

Alternative armament arrangements are provided, consisting of either four 20-mm. cannon or two 20-mm. cannon and two 0.5-in. machine guns, or two 20-mm. cannon and four 0.303-in. machine guns. The plane can carry one bomb, of either 250 lbs. or 500 lbs., under the fuselage, or can carry a drop tank instead of the bomb. *British Air Commission*, Washington, D.C.

welding with a paint brush?

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To solve a difficult welding problem, Eimac laboratory technicians compounded a welding alloy that could be applied with a paint brush. The alloy flows easily under an arc to complete the weld, yet subsequent heating to temperatures as high as 2900 degrees Centigrade will not destroy the weld.

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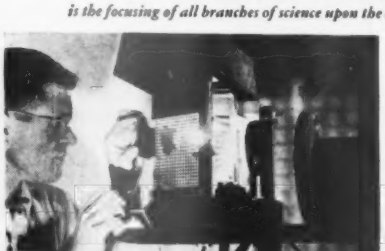

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METALLURGY... Compounding special alloys of metals.

OPTICS... For studying the effects of processing.

ELECTRONICS... Welded elements in electron vacuum tubes withstand tremendous heat.

BOOKS

With the exception of aeronautical annuals and books published outside the United States, books reviewed in this section may be borrowed without charge from The Paul Kollsman Library of the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

Basic Structures

F. R. Shanley

Contents: Structural Analysis Methods; Forces and Moments; Force Transmission; Equilibrium and Reactions; Stability, Constraints, and Redundancies; Behavior of Materials Under Load; Axially Loaded Members; Transverse Forces; Truss Analysis; Shear Webs; Curved Shear Webs; Torsion; Bending—Symmetrical; Unsymmetrical Bending; Bending (Special Cases); Bending Deflections; Combined Bending and Shear; Combined Shear and Torsion; Combined Bending and Axial Loading; Combined Stresses; Joints.

Although airplanes are not mentioned in the title, the choice of the topics and examples and the point of view from which the author regards them make *Basic Structures* an excellent introduction to airplane structural analysis. Only elementary algebra, trigonometry, and physics are required of the reader for an understanding of the derivation and use of the formulas and methods of analysis presented. However, the absence of higher mathematics is not a consequence of ignorance or incompetence on the part of the author, as in the case of some so-called simplified texts. It results from the purpose of presenting the fundamentals of structural analysis to readers who have no engineering education.

It might be argued from an academic standpoint that the student of stress analysis should learn first how to use the calculus. However, during the present emergency the airplane industry, although willing to initiate training courses in order to alleviate the shortage of trained personnel, had neither the time nor the desire to put prospective employees through a regular college curriculum. If the experience gained in the last few years justifies the employment in structural design of men without an engineering college background, *Basic Structures* should prove of great help in the realization of such a program.

It is really astonishing how Shanley can explain and make the reader visualize the problems of force transmission without the powerful aid of the calculus. Topics like stress concentration, Saint-Venant's principle, curved beams, the effects of inelastic deformations on failure in bending and torsion, the conception of redundancy, etc., are adequately discussed.

In spite of the author's lack of sufficient time for carefully checking the manuscript—as stated in the introduction to the book—there seem to be very few errors in the text. The reviewer disagrees with the author's designation of the so-called classical shear formula as just "a modification of the more general unit method." Shanley's unit method and the common shear formula result from applying to different particular cases the same fundamental considerations of equilibrium. The first definition of the shear center (on p. 175) in reality defines one coordinate of the shear center. Moreover, the exactness of the statement, ". . . the only possible form of force transmission through a finite distance is axial," may be questioned. In general, the exactness of presentation is far above the usual level of elementary textbooks. This reviewer particularly welcomes the author's great care in calling the reader's attention to possible misinterpretations, showing how calculations should not be carried out, and in presenting consistently the structural designer's standpoint. Shanley is ingenious in explaining the basic conceptions of truss analysis through the visualization of displacements, and of the warping in torsion by using the example of a circular shell with nonuniform wall thickness.

Basic Structures should become popular with persons having no formal education beyond high school who wish to learn the fundamentals of airplane structural analysis. It can be highly recommended to students of structures in general, since the aeronautical point of view provides a broader basis for the understanding of the fundamental conceptions of structures than does the classic structural point of view. John Wiley & Sons, Inc., New York, 1944; 392 pages, $4.50.

Airports and the Courts

Charles S. Rhyne

Contents: Airport Acquisition; Condemnation of Property for Airport Purposes; Airport Leases; Regulations Governing Use of Airports; Taxation of Airports; Damage Claims Against Airport Owners and Operators; Airspace Rights of Aviators and Landowners; Airport Approach Protection—Airport Zoning.

A most timely compilation of court decisions in cases involving airports, this book will serve as a helpful guide to the designers, builders, and operators of airfields of all sizes.

Every phase of airport operation that has come under the critical judgment of the law is reviewed and the latest decisions are summarized. The book gives between its covers all of the decisions of the courts involving airports, as well as an analysis of the legal principles used in these decisions. In addition, there is a consideration of Federal, State, and local legislation applicable to airports.

A table of law reviews and other articles is included. The table of court decisions annotates court decisions and aviation and airport statutes, with citations to official sources. More than 500 footnotes throughout the volume give citations of court decisions, articles, official reports, books, and other references on each subject discussed. National Institute of Municipal Law Officers, Washington, 1944; 222 pages, $5.00.

Preflight Study Manual for Civil Air Patrol Cadets

Prepared by Headquarters AAF, Office of Flying Safety

Contents: Cadets of the CAP; Some Facts of Army Life; How to Spot Planes in a Flash; Getting in Shape to Fly; Communications; What Makes an Airplane Fly; Weather in the Making; Your Body in Flight; Ground Work; How to Find Your Way in the Sky.

This instruction book for Civil Air Patrol cadets gives them the general information they need to enter the Patrol, to know how the Army Air Forces operates, and to understand their relationship to the A.A.F.

Recognition, types of American aircraft, and other useful information for the student pilot are presented. Following the section on flying instruction there are chapters on radio, meteorology, navigation, and many of the other subjects a pilot should understand.

The manual is excellently illustrated and would be useful to all preflight students if it were to be made available to the public. At present it is issued only to the cadets of the C.A.P. Civil Air Patrol, New York, 1944.

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A textbook for preflight students, aviation cadets, and teachers contains rudimentary instructions for flying. The information is presented in a simple condensed form. In dealing with the elements of history, aerodynamics, navigation, load factors, and aircraft engines, the author avoids language that is too technical for the average reader. Included in the text are 200 multiple-choice questions, with answers, patterned after the Civil Aeronautics Authority's tests for those preparing to take the pilot's examinations. Essential Books, New York, 1944; 264 pages, $2.50.

What Ship is That?

E. C. Talbot-Booth

Contents: Some Principal Parts of a Merchant Vessel; Types of Hull; Types of Bows or Stems and Sterns; Types of Superstructure or Upperworks; Types of Funnels; Types of Masts, Ventilators, Derrick-Posts (Samson or King Posts), etc.; Types of Deck Cranes, Davits, etc.; Some Types of Merchant Vessels; Comparative Sizes of Typical Vessels Engaged on Various Trades and Services; Some Errors and Distortions Caused by Weather and Other Conditions; Estimation of Speed and Age of Ships, Smoke as an Aid to Recognition; Estimating the Tonnage and Size of Ships; Flags as an Aid to Recognition; Systems of Nomenclature Adopted by Shipping Companies, Types of Sailing Vessels, Silhouettes of Merchant Ships, Index to Merchant Ships; Silhouettes of Yachts, etc., Index to Yachts, Cable Ships, etc.; Principal Features of a Battleship; Types of Warship Hulls; Types of Warship Bows and Sterns; Types of Warship Funnels and Masts; Guns and Torpedo Tubes; Some Types of Warships; Some Common Formations of a Fleet or Squadron; Range of Naval Guns and Torpedoes, Silhouettes of Warships, Index to Warships.

This compilation of silhouettes and other methods of identification of merchant ships, yachts, and warships of all nations is one of the most comprehensive books on the subject. Drawings of port and starboard views are given of hundreds of individual ships and of classes and types of vessels, with figures for the tonnage, length, beam, and speed of each. Allied, neutral, and enemy ships are included. Separate indexes list the names of all ships in each category.

Methods for quick identification of noticeable features of construction are explained in great detail. Instructions for ship recognition utilize the shape and arrangement of the hull, bow, stern, superstructure, funnels, masts, and equipment. Other points dealt with are code and signal flags, nomenclature, and estimation of the size, age, and speed of ships.

The book will be useful to naval pilots and crews whose duty it is to identify the objects of their attacks. Although the inclusion of such information would be difficult, an airman's view of each ship would have made the guide of even greater value to the crews of bombing and observation aircraft. Didier Publishing Company, New York, 1944; 1 volume, $4.00.

Arc and Acetylene Welding

Harry Kerwin

Contents: The Weld; Welding Equipment; Preparation for Welding; Basic Practice Plates; Aircraft Welding, Final Test Plates of Army and Navy *A* Test; Pipe Welding, Forehand and Lindeweld Techniques; Identification of Metals; Expansion and Contraction; Cast-Iron Welding and Cutting; Hard Facing and Alloy Welding; Brazing; Tables, Safety Rules; The Welding Machine and Its Care; The Electrode; Wearing Apparel, The Welding Booth and Welding Bench; Beading Technique; Expansion and Contraction; Cast-Iron Welding; Aluminum Welding; Building Up and Hard Facing; Testing Weld Samples.

Designed particularly for the use of the general shop instructor or the beginning student, this book describes the step-by-step procedure necessary to make an acetylene or electric weld. Because the student must master the actual manipulative technique of welding before he can advance to the welding of alloy metals or intelligently study construction and joint design, special welding techniques are stressed.

The author's aim has been to provide a text that will shorten the student's training period and eliminate hours of useless practice spent on the wrong procedure. McGraw-Hill Book Company, Inc., New York, 1944; 240 pages, $2.50.

Compass of the World

Edited by Hans W. Weigert and Vilhjalmur Stefansson

Contents: The New World; Geography and Geopolitics; New Directions and Skyways; Reflections on the Heartland; The Northward Course; Reflections on Asia; The Shifting Balance of Man Power.

This book attempts to fill a wide gap that the political-geographical thinking and planning in the United States must try to bridge. The shrinking world requires new vision, and the authors correct some of the basic misconceptions of political geography which are confusing the minds of the public

Twenty-eight contributed articles by specialists in each of the fields represented comprise this symposium. Consequently, the scope of the book is broad and it does not present the ideas of any one person. Sixteen of the articles, previously published in magazines or books, have been revised or rewritten by the authors. The care with which the material has been selected will give it an authoritative character.

The fact that Dr. Stefansson is one of the editors might give the impression that the Arctic regions and the air-transport possibilities there might be stressed. However, the reader will find the emphasis on Europe and Asia as shifting centers of political and economic importance resulting from the impact of air power and air transport.

The compilation is one of the most important that has yet appeared. It should be widely read so that those in aviation, as well as the general public, will have a clearer idea of the possible changes that the airplane will make in future world affairs. The Macmillan Company, New York, 1944; 466 pages, $3.50.

The Wild Blue Yonder

Emile Gauvreau

This book treats of two periods. The first is of the aviation program of the United States in World War I. The author believes that Sir Basil Zaharoff, who had such a great control over the munitions industry of Europe, was a potent force in holding back the manufacture of military airplanes in the United States. He quotes many letters to give credence to this claim. Like many other misinformed critics of the output of the American aircraft industry during the last war, he does not blame the foreign missions who urged the United States to build airfields and train pilots, but to avoid the use of critical aircraft material for making pursuit and bombing planes.

He avoids mentioning the many uses to which the appropriations were put in this country and attempts to show "how the American Air Force got only 196 airplanes for $1,650,000." He traces this to the control of Zaharoff over what he terms the "American aircraft monopoly."

As the author was Director of the Committee on Patents of the House of Representatives in 1935 in its investigation under Congressman Sirovich, he reveals many of the claims that have long since been forgotten. He asserts that Gen. William Mitchell instigated the investigation and was its guiding spirit. The first half of the book is a repetition of many of the statements made in Congress and in investigations about the work of the aircraft industry during the last war.

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When he turns to the conduct of the present war he shows the ever-present confirmation of General Mitchell's foresight, imagination, and courage. The little group of Mitchell adherents—Arnold, Spaatz, Brereton, Chennault, Kenny, Brant, Hunter, Strahm, H. L. George, Doolittle, Robert Olds, Eaker, Brett, Andrews, and Atkinson—after many setbacks and much discouragement came to the top as the directing geniuses of the great new Army Air Forces.

It is significant that there is no claim that the aircraft industry in the great war effort has been other than efficient and productive. The author's concluding statements repeat General Mitchell's demands for an air department separate from and co-equal with the Army and the Navy. E. P. Dutton & Company, Inc., New York, 1944; 386 pages, $3.00.

Essentials of Aerial Surveying and Photo Interpretation

Talbert Abrams

Contents: Mathematics, Simplified and Abbreviated; Surveying; Maps and Globes; Map Projections; Orientation and Location; Topographic Drafting; How Aerial Photographs are Made; Stereovision; Interpretation; Ground Form Lines; Stereoplotting Instruments; Topographic Relief Models; Restitution and Rectification of Aerial Photographs; Template Methods of Radial Line Control; How to Make a Mosaic from Aerial Photographs; The Tri-Metrogon System of World Charting.

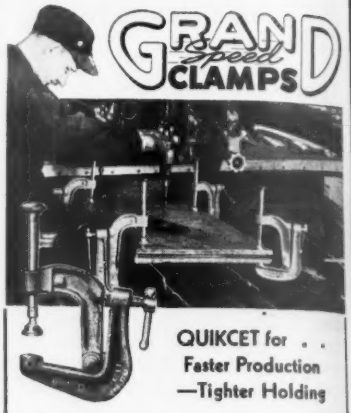
Present-day methods of aerial photographic interpretation and map making are described, as well as the operation of modern photogrammetric equipment. The subject matter is presented in a simple and useful form so that the reader can readily understand the many uses and applications of aerial photographs. Long mathematical explanations are reduced to simple and practical problems in arithmetic.

Special attention is given to topographic forms that, on a map, are often confusing to the novice. The section on advanced map reading contains many hints as to techniques and methods. A glossary and a bibliography are offered. McGraw-Hill Book Company, Inc., New York, 1944; 289 pages, $3.00.

Materials Management: A Problem of the Airframe Industry

Howard T. Lewis and Charles A. Livesey

Contents: Development of Materials Organization; Intradivision Organization; Product Versus Functional Organization: Internal Audit; Inventory Control Department; Contact with Outside Departments; Some Contro-



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versial Organization Questions; Responsibility for Materials Control; Product versus Functional Organization; Location of Stores Responsibility; Separate Inventory Control Department; Inventory Record Audit; Responsibility for Surplus Disposal; The Problem of Personnel; Bill of Materials; Ordering; Purchasing; Receipt—Inspection—Payment; Disbursement Control; Inventory Control.

This report deals with the management of materials procurement and inventories in the air-frame industry. It has a direct bearing on the difficulties expected in termination of contracts. The study suggests the necessity for recognition by executives of the fundamental nature of the materials management problem and its relationship to other parts of the organization in preparing not only for termination, but also for the postwar operating period.

The following recommendations are made: (1) The number of items should be scrutinized with a view to eliminating as many as possible through standardization. (2) Materials, equipment, and parts must be classified so as to permit control by classes rather than by individual items. Varying procedures for ordering and for review and analysis can thereafter be established to provide maximum control with a minimum amount of work. (3) Inventory records must be made more accurate so that persons using them will have confidence in the facts they portray. (4) A definite assignment of the task of reviewing and analyzing inventory position must be made to a particular group not concerned with other pressing duties. Day-to-day tasks of materials divisions are so urgent that review and analysis of inventories continually take a back seat. They should be made the primary task of some group rather than an incidental responsibility of everyone. (5) Summary statements of inventory position should be prepared at reasonable intervals for review by company chief executives. In no other way will the importance of reducing inventories be communicated down the organization line to persons actually making decisions that affect the company's position. Business Research Studies Number 31; Harvard University Graduate School of Business Administration, Boston, 1944; 48 pages, $1.50.

Handbook of Air Navigation

Capt. W. J. Vanderkloot

Contents: Form of the Earth; Maps and Charts; Magnetism and Compasses; Radio Signals; Dead-Reckoning Navigation; Astronomical Navigation; Tides; Meteorology.

A manual of air navigation is based on the standards required by the International Committee for Air Navigation for the carriage of passengers between foreign countries. The author deals with the theoretical requirements in a non-technical manner.

A feature of the book is the inclusion of two charts of actual trips carried out by the author. The errors and working of the charts are discussed in the text for the benefit of the student navigator. Another feature is the treatment of the value of two-position line and three-position line fixes.

The book is written to comply with the standards required for navigators' licenses in Great Britain, except that international legislation has been omitted; this is done in view of the fact that it will undoubtedly be altered after the cessation of hostilities. For the reader not familiar with the mathematics required, an outline of the necessary formulas is given in Appendix I. Except for international legislation, the book gives the full theory of navigation with the introduction of numerous practical suggestions. Other appendixes give equivalents in various measurements, the International Morse Code, and the pressure and temperature of the atmosphere at different altitudes. McGraw-Hill Book Company, Inc., New York, 1944; 333 pages, $3.50.

Second Report of an Independent Committee on the Future of Civil Aviation

Contents: "Freedom of the Air" and International Relations; Air Bases; National Security; Control of Routes, Licences to Operate and Methods of Operation Including Intensity, Frequency and Standards; Administration of Empire Air Transport; Nationalisation, Monopoly or Private Enterprise; Subsidies (Direct and Indirect), Grants and Air Mail Contracts; Economics, Costs of Operation, Speeds and Obsolescence of Equipment; Internationalisation; Cabotage; Technical Problems; Engines; Equipment, Ground and Flying; Airports.

This British committee, all the members of which have had long aviation experience although none is engaged in the manufacture of air frames or engines, has prepared a second report containing much new material.

It discusses briefly all phases of civil aviation, classifying the three principal problems as political, operational, and technical. The political and operational problems are treated together because they overlap. The report will be of interest to American observers who will read how many of the conclusions are based on air-transport organization in the United States.

The members favor an international regulatory authority, to have jurisdiction over route areas. They are against any monopoly of a nation's air transport by a subsidized "chosen instrument." They are opposed to subsidies except in special instances, and recommend that these be in the form of loans. They believe that commercial airplanes should be flown more hours during their active life of 5 years and then, when usable, should be employed for low-fare service.

Airports, equipment, engines, cabotage, and technical problems are all studied in the briefest and most direct presentation. It is a report that will reward the reader by giving challenging and stimulating facts, deductions, and conclusions. Independent Committee on Civil Aviation, London, 1944; 47 pages.

Handbook of Airplane Maintenance and Operation

Edited by Specialists in the Field of Aeronautics

Contents: The Internal-Combustion Engine; The Aircraft Engine; The Lubrication System; The Carburetor; Supercharging of Aircraft Engines; Types of Aircraft Engines and Their Construction; Aircraft Magnetos; Spark Plugs; Aircraft Engine Installation Requirements; Overhaul of the Aircraft Engine; Installation of the Aircraft Engine in the Aircraft Structure; Methods of Starting Aircraft Engines; Maintenance of the Engine; Propellers; Aircraft Instruments; Aircraft Landing Gears; Aircraft Structure and Construction; Maintenance and Overhaul of the Airplane Structure; The Construction and Repair of Flying Boats.

Written to provide the novice with an understanding of aircraft fundamentals, this book is also intended to serve as a general reference and refresher manual for the expert. Elements of the airplane are considered with respect to basic theory, construction, functioning, and repair.

This method of presentation has been chosen as most suitable because the modern aircraft-manufacturing system is based on specialization in production, and persons engaged in detail work seldom have the opportunity to see the complete assembly. The various chapters have been contributed by specialists in the particular fields about which they write. The larger part of the book is given to aircraft engines, engine components, and maintenance, but other sections discuss instruments, landing gears, structures, overhaul, and repair.

The book contains line drawings and shaded illustrations. The plan of illustration followed shows minute details and methods of operations, and lends itself to the extensive labelling system that is employed to supplement the text. National Aeronautics Council, Inc., New York, 1944; 502 pages, $4.50.

Air Transport and Civil Aviation Year Book, 1943

Contents: Formal Articles; Memoranda and Statements of Policy; Air Transport Committees; The Principal Air Transport Companies; Air Transport Companies of the World; Alphabetical Air Guide; Distances Between Airports and Town Centres.

As air transport is one of the principal postwar outlets for aircraft and one of the main fields for the future employment of wartime pilots, this compilation

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of studies from different English points of view will be helpful in giving an idea of how the British are thinking about this service that will be so essential to the British Empire.

The articles, written by many of the leaders of English aviation, give differing views. Evidently the English are struggling to get a fixed policy on which there can be general agreement. The reading of the book will not give the impression of much unanimity of thought. The formal articles are as follows: "Air Transport," by the Marquess of Londonderry; "Freedom for Air Line Traffic After the War," by Air Chief Marshal Sir Arthur Longmore; "Airports and Air Planning," by F. G. Miles; "The Future of Air Commerce," by Major R. H. Thornton; "After the War Trade Will Follow the Plane," by Sir Miles Thomas; "Plans for the Development and Control of Air Transport after the War," by the aeronautical correspondent of *The Times;* "Co-Operation Better Than Competition," by Air Commodore A. W. F. Glenny.

Following the original articles are memoranda and statements of policy of the government and private agencies, and the interesting reports of various air transport committees. There is an excellent section on air transport companies of the world.

This first edition of this annual will be provocative and of especial interest to American air-transport officials. Todd Publishing Company, London, 1943; 159 pages, 10*s*. 6*d*.

Cambridge Tracts in Mathematics and Mathematical Physics, Fourier Series No. 38

G. H. Hardy and W. W. Rogosinski

Contents: Generalities; Fourier Series in Hilbert Space; Further Properties of Trigonometrical Fourier Series; Convergence of Fourier Series; Summability of Fourier Series; Applications of the Theorems of Chapter V; General Trigonometrical Series.

This study is based on lectures given by the authors at Cambridge University and elsewhere. Although concise, it is considered complete enough to serve as an introduction to Zygmund's standard treatise. The study is not intended for physicists or beginners but for mathematicians who have a preparatory knowledge and are interested primarily in the theory of the Fourier series. An acquaintance with the elements of Lebesgue's theory of integration is assumed. The Macmillan Company, New York, 1944; 100 pages, $1.75.

Automatic Control Engineering

Ed Sinclair Smith

Contents: Introduction to the Art of Control; Terminology; Descriptive Treatment of Control; Applications of Regulators to Plants; Quantitative Analysis of Control; Various Aspects of Control; Tables Commonly Used in Control Engineering; Review of Basic Physics; The Mathematics of Transients, a Short Review; Analytic Methods for the Solution of Differential Equations; Functions of a Complex Variable; The Laplace Transform Method; The Laplace Transform in Practical Use; References on Control.

The book is devoted entirely to control engineering. Because the book has been written for the purpose of aiding the engineer in solving problems of automatic control wherever they may occur, the information is applicable to aircraft control systems. The first four chapters employ a qualitative nonmathematical approach to the subject. The quantitative treatment is covered in the last three chapters and certain sections of the appendix. In writing the book, the author's object has been to teach the reader to understand and think. For this reason he has avoided the use of solutions based on formulas. Because literature on the subject has been widely scattered, about half of the book is devoted to appendixes containing engineering information collected from many sources. McGraw-Hill Book Company, Inc., New York, 1944; 367 pages, $4.00.

Book Notes

Unsung Heroes of the Air, by A. H. Narracott; Frederick Muller, Ltd., London, 1943; 168 pages, 7*s*. 6*d*.

In England, as in the United States, there are thousands of men rendering invaluable service to the armed forces whose work does not receive the acclaim of the public.

In civil aviation there are the transport and ferry pilots. Some of them come under fire of the enemy occasionally, but ordinarily their work is routine and little known. The "Ancient and Tattered Airmen," as the Air Transport Auxiliary is nicknamed, have done noteworthy work in England.

The test pilots, both in the aircraft industry and in the services, fly under the hazardous conditions of experimentation. The men of "Met," as the Meteorological Flight is called, fly to learn the weather conditions. The flying instructors are also among the unsung heroes.

All these and many other services are described in this book and are given due credit for their part in the war effort.

Invasion Diary, by Richard Tregaskis; Random House, New York, 1944; 245 pages, $2.75.

This well-known correspondent has followed his *Guadalcanal Diary* with a successor relating his day-by-day experiences during the invasion of Italy. The earlier book gave the story of the U.S. Marines, while the present volume relates the achievements of the Army.

While participating in the battle for Italy and when within 7 miles of Cassino, the author was wounded by a shell fragment. The latter part of his book describes vividly the sensations of receiving a serious head wound with resulting partial paralysis. He went from emergency hospitals in Italy to those in Africa and finally to Walter Reed Hospital in Washington. After a successful operation there, he returned to the war.

Zweng Aviation Dictionary, compiled and edited by Charles A. Zweng; Pan American Navigation Service, N. Hollywood, Calif., 1944; 366 pages, $6.00.

This encyclopedic type of dictionary will prove to be a valuable addition to the many reference books on the nomenclature of aeronautics.

Each new definition broadens our knowledge of words or terms. To make this dictionary of exceptional value there are included the more frequently used terms of aerodynamics, aircraft and theory of flight, air navigation, aircraft radio and instruments, and meteorology. Short sketches of a limited number of persons who have contributed to the advancement of aviation in America have been included. Brief descriptions are also given of certain airplanes, the types being listed alphabetically according to the name of the manufacturer. Full-page photographs of combat and transport airplanes and instruments serve as illustrations.

For the painstaking research and the effort to provide a most useful reference book, the aeronautical profession will be grateful. The book should be in every aircraft laboratory and factory.

Opportunities for Youth in Air Transportation, by Frances Aves Smith and Nickolaus L. Engelhardt, Jr.; Air Age Education Research, New York, 1944; 26 pages, $0.25.

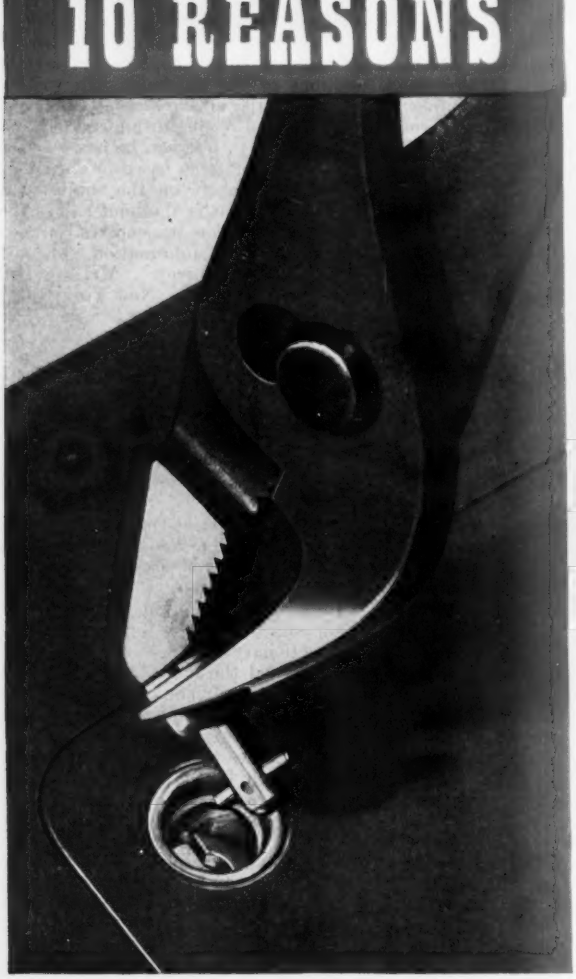
Opportunities for young people in the various branches of air transportation are outlined in a pamphlet of 26 pages. The qualifications required for different positions are given and suitable preparatory courses are suggested. The work done by the air crews, the maintenance shops, the office staffs, and the airport personnel is explained.

An Aircrafty Tale, by S. M-M; Sir Isaac Pitman & Sons, Ltd., London; 34 pages, 3*s*.

A boy of 7 years is taken on a visit to the de Havilland aircraft factory. He is shown how airplanes are manufactured and is taken for a short flight. The explanations given to him make the book one that will fascinate youngsters.

One Man's War, by Sgt. Charles E. Kelly with Pete Martin; Alfred

10 REASONS



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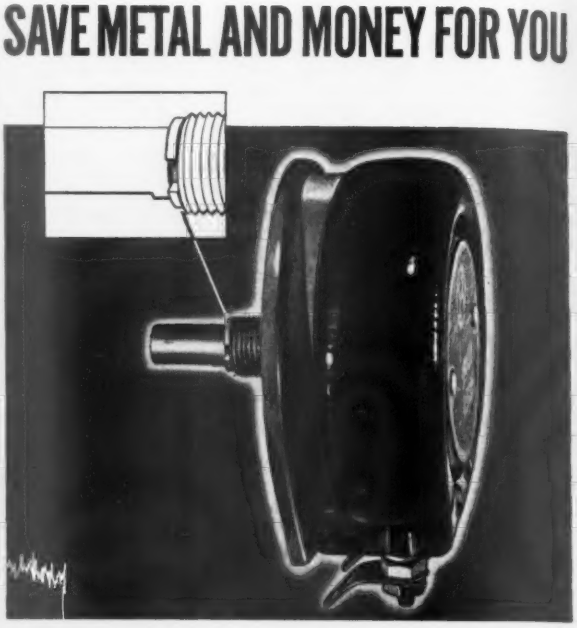

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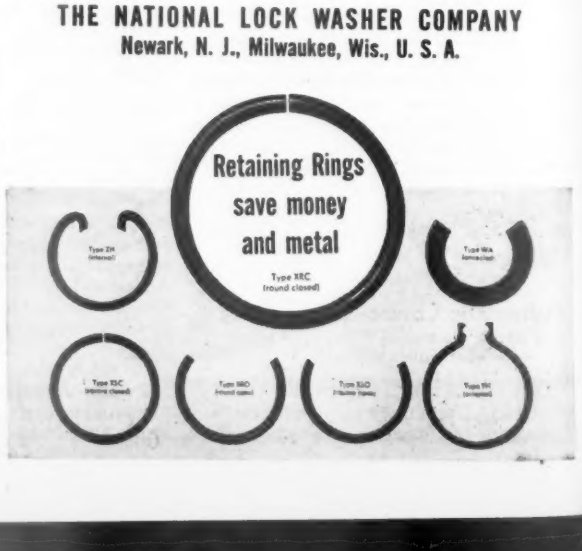


A. Knopf, New York, 1944; 182 pages, $2.00.

This story of one of the great heroes of this war has an aviation interest only to the extent that Navy airplanes brought him back to a public who showed this gallant boy from Pittsburgh how such heroism was appreciated at home.

Our Army at War; Harper & Brothers, New York, 1944; 1 volume, $3.00.

As a photographic record of the U.S. Army's first two years at war, this book of official photographs presents battle scenes and glimpses of the life of the combat soldier and his victims. Each campaign covered in this volume is prefaced by a brief section of introductory text prepared by the War Department. For the reader's better understanding the volume also contains four detailed maps. Many of the pictures show the activities of the Army Air Forces.

Carefully selected, with a leaning toward action pictures, the series of 482 illustrations forms a vivid pictorial history of the war from Pearl Harbor to Teheran.

Winged Victory, by Moss Hart; Random House, New York, 1943; 198 pages, $2.00.

This play, which has had such a remarkable success, was written after the author, Moss Hart, had flown 28,000 miles visiting Army Air Forces camps. The proceeds from the box office go to the Army Relief Fund.

It is a story of the men in the Army Air Forces from induction to combat. Several hundred air force personnel took part in the production. In addition, about 50 civilian women took the parts of Wacs, soldiers' wives, and mothers.

The volume is a word-for-word book of the play in two acts and 18 scenes. Those who had the privilege of seeing the play will enjoy reading the full dialogue, and those who did not see it will have the pleasure of following the airman's career in play form.

Can Do! The Story of the Seabees, by Lt. (j.g.) William Bradford Huie; E. P. Dutton and Company, Inc., New York, 1944; 250 pages, $2.75.

It was at Guadalcanal that the Seabees came to be known as the "can do boys." They had experienced 184 alerts, totaling 208 hours and 40 min., and were bombed 67 times. Yet they completed the construction work around Henderson Field and started their record which has brought their units world fame.

They aided General MacArthur in New Guinea, New Britian, and the Admiralties. They built a flight strip at Munda. They "ringed" Rabaul with airfields. In fact, there is hardly an airman in the Army Air Forces or in naval aviation who is not appreciative of the preflight construction work done by this remarkable new part of the Navy.

At the end of the book are two lists of Seabee personnel: those who won decorations up to March 1, 1944, and those reported as casualties to the same date. There are also 72 pages of drawings and photographs depicting the activities of the corps. This book is a worthy history of the accomplishments of the Seabees.

The Ships and Aircraft of the United States Fleet, by James C. Fahey; Ships and Aircraft, New York, 1944; 80 pages, $1.00.

The second edition of this useful booklet lists only a fraction of the U.S. Navy's huge fleet. It does give pictures and useful data about the leading United States naval vessels, aircraft, and lighter-than-air equipment.

Seaplane tenders are described with other fleet auxiliaries. The vessels and aircraft of the Coast Guard are included. It is a handy guide that gives essential information regarding the present development of naval sea and air power.

Outlook for Air Cargo in Fresh Produce, edited by N. Stanley Oates; Wayne University Press, Detroit, 1944; 91 pages.

The addresses given at the National Air Cargo Conference in March in Detroit are printed in this pamphlet. The conference was attended by leaders in air transport and in other agencies concerned with the transportation of produce.

The principal address was given by Dr. Spencer A. Larsen, Director of Air Cargo Research of Wayne University. He presented a list of commodities that would be attracted to air transport at various rates ranging from 15 cents per ton-mile down to 3 cents per ton-mile. Tables and charts show the estimated potential volume of such traffic and the comparative prices of commodities transported by air and by rail.

Air-line specialists pointed out that even the maximum rate of 15 cents per ton-mile was too low for present flying equipment and could only be reached by the use of new, specially constructed cargo aircraft. The consensus of the speakers was that the problem was one of great interest and that such forward-looking studies were stimulating investigations of a great possible market for air carriers.

East of Malta, West of Suez, by Bartimeus; Little, Brown and Company, Boston, 1944; 221 pages, $2.50.

This is the dramatic story of the winning of naval control of the Mediterranean by the forces under Admiral Sir Andrew Cunningham. It describes the work of the British navy in the Mediterranean from the outbreak of the war up to the conquest of Tunisia in the spring of 1943, by which time British command of the Mediterranean was assured.

The part played by naval aircraft at Taranto, when the principal battleships of the Italian navy were put out of the war, is given with great credit to the airmen. Although aircraft did not have such an important role on the sea as on land in the recapture of Mussolini's Maré Nostrum and its borderland, it is clear that the umbrella of air power was ever present.

The Liquidation of War Production, by A. D. H. Kaplan; McGraw-Hill Book Company, Inc., New York, 1944; 133 pages, $1.50.

This book will be of the greatest interest to every executive in the aircraft industry who is faced with the problem of postwar cancellation of contracts. It was prepared for the Committee for Economic Development and is the result of extensive research.

Although it applies to all industry, it has many references to the peculiarly acute problem of the aircraft manufacturers. It evaluates the extent of the liquidation and makes recommendations as to the best methods to be followed by the Government. There is a careful analysis of the different problems of contract cancellation in many fields.

The disposal of surplus supplies and the disposition of plants and equipment are discussed. A final chapter on clearing the way to reconversion rounds out the study.

The problem is one of the most complex economic tasks the nation has ever faced. It is a task that can be performed only through clearly defined policies and proper administration. This book will be a useful and stimulating aid to preparation for the day of victory and resumption of peacetime responsibility.

The German Army of To-Day, by Wilhelm Necker; Lindsay Drummond Ltd., London, 1943; 205 pages, 6s.

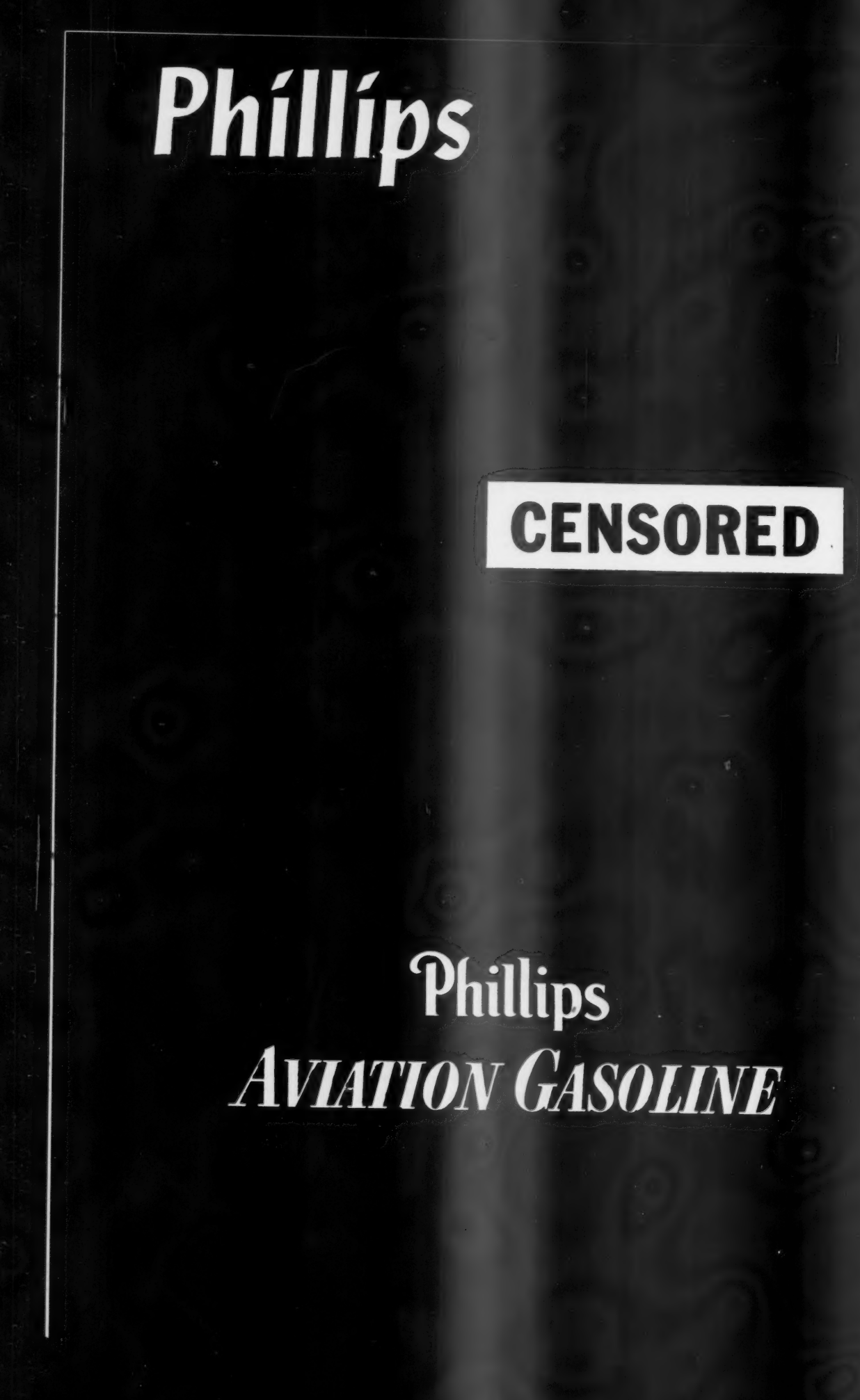
This book, written by a former German officer, will give the professional soldier and the public a detailed account of the many components of the German war machine. The information is authoritative and is arranged so that it may be of the greatest use to specialists. It is intended to advise soldiers of the Allied armies about the organization, equipment, and operations of the various units of the German combat forces likely to be encountered in battle. Diagrams and photographs illustrate the tactics and the use of the weapons.

The chapters on the Luftwaffe are especially informative. They discuss the organization of the German air force, the duties of each unit, and its relationship to the army and navy. The methods used in tactical and strategic work of the "air fleets" are described in detail. As the antiaircraft artillery, the Flak Troops, and the airborne divisions are all under the Luftwaffe, they form a complete air unit with the bomber and fighter commands.

The book will be of the greatest use to all branches of our Army in providing them with information about the enemy forces they are encountering.

General Meteorology, by Horace Robert Byers; McGraw-Hill Book Company, Inc., New York, 1944; 645 pages, $5.00.

This book is a development of a text titled "Synoptic and Aeronautical Meteorology" in which methods of weather analysis developed by Scandinavian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meteorologists were set forth. It has been arranged to meet the present need for a text embodying fundamentals as well as modern developments in synoptic meteorology. It may be adapted for use in courses of varying lengths by omitting certain chapters.

The First Flying Book, by Campbell Tatham; Franklin Watts, Inc., New York, 1944; 41 pages, $1.00.

A book for boys and girls interested in aviation. An arrangement of simple words, diagrams, and pictures is used to give the young reader an understanding of the subject.

We Jumped to Fight, by Col. Edson D. Raff; Eagle Books, New York, 1944; 207 pages, $2.50.

The leader of the first paratrooper force to be used in the European campaign relates his personal experiences in this dramatic element of warfare. He tells of the intensive course of training both in this country and in England.

Suddenly his outfit was ordered to Tunisia and while there participated in the epic defeat of the Italians and Germans around Faid Pass, Gafsa, and Gabes. The cooperation with the French troops was remarkably effective. The paratroopers made three sensational jumps and, between times, they fought with the infantry.

Colonel Raff's story is a record of the conquest of the key cities of inland Tunisia which confined the enemy to the coast where they were eventually captured. "Raff's Army," as his force was called, performed deeds which will always reflect honor on the American soldier. It records the baptism by fire of the paratroopers who are destined to play such an important role in future warfare.

Radio Direction Finders, by Donald S. Bond; McGraw-Hill Book Company, Inc., New York, 1944; 287 pages, $3.00.

A text and reference book is provided for electrical engineers specializing in the design or theory of direction finders for aircraft, shipboard, or fixed-station use. The author has combined a qualitative description of the practical systems in use with an analytic study of the underlying phenomena. Particular attention is paid to current trends, such as the use of ultra-high frequencies, the employment of visual and automatic direction finders, the better understanding of Adcock systems, and the analysis of the behavior of direction finders for the reception of ionosphere waves. There is included a considerable amount of material of a handbook type, for it is believed that this will be useful as a reference by engineers concerned with the design of direction-finder equipment or by those engaged in the study of the simpler aspects of the phenomena of wave propagation.

For comparison purposes, data are given in charts on the maximum range of transmission over a wide range of frequencies. Summaries are made in tabular form of phase-shift performance of resonant circuits. Circuit diagrams of commercial direction finders and representative equipment of other classifications are given with enough descriptive information so that a user of this apparatus can study the principles of operation with no other text material. Thus, other systems can be analyzed because of the basic similarity of the principles involved. Instructions are given on such subjects as the establishment of standard fields for the testing of direction finders and the calibration of aircraft direction finders in flight.

Bombers Fly East, by Bruce Sanders; Herbert Jenkins Limited, London, 1944; 186 pages, 8*s.* 6*d.*

This is the story of the Royal Air Force's three heavy commands—Bomber, Coastal, and Ferry. It relates the experiences of the pilots who ferry the North Atlantic and the stories of those who search the seas for the submarines. The longer part of the book is devoted to the work of the bombing pilots over Germany. The English, Dutch, Polish, and American pilots all have their place in this strategic effort to bring the Germans to surrender.

Here is the human-interest story of the men in the eastward-flying bombers who have taken possession of the enemy's skies.

Mechanics Vest Pocket Reference Book, compiled and published by John H. Wolfe and Everett R. Phelps; Ziff-Davis Publishing Company, Chicago, 1944; 214 pages, $1.25.

The fourth and revised edition of this booklet contains ready-reference tables of data for mechanics. It includes numerous tables of measurements, forms, threads, gauges, keys, gears, and other mechanical data, with instructions for interpolation.

Know Your War Planes; The Coca Cola Company, Atlanta, Ga., 1944; 42 pages, $0.10.

This booklet contains 26 reproductions of paintings of American fighting planes in action, and 96 silhouettes of warplanes of the United Nations and the Axis powers.

The text includes explanations of different methods of identification of aircraft, based on wing patterns, engine details, fuselage shapes, tail groups, and other means of recognition.

A War Atlas for Americans, prepared with the assistance of the Office of War Information; Simon and Schuster, New York, 1944; 86 pages, $2.50.

This account of the war on all fronts is written around global maps. It is designed to explain the basic pattern of the war. It describes the moves made by the Axis and the routes the Allies may take in the future. The atlas is intended to assist Americans in following the movements of the Allies in their march to victory.

The maps are not only extremely detailed but are made according to the modern method of avoiding distortion as much as possible. They show the spherical form of the earth and are drawn from points of projection, designated by latitude and longitude, differing from the traditional north-south orientation. The purpose is to show the angle of approach as seen through the eyes of the invading force. The maps are integrated with the text and should afford an officially approved reference guide to the geography of the war.

New Line of Position Tables, by P. V. H. Weems; Weems System of Navigation, Annapolis, Md., 1943; 41 pages, $2.00.

These tables are essentially a rearrangement of the author's original *Line of Position Book* for navigators, to which has been added a new value for azimuth. Values for all hour angles are arranged in one column for a given value of latitude. The tables provide a uniform solution for all conditions.

Four alternate methods are given for the solution of azimuth, with explanations and sample problems. The use of one of these methods, the Rust Azimuth Diagram, is recommended by the author for certain conditions. Instructions are given for the computations.

Special instructions are included for use when the observed celestial body is near the prime vertical.

Plastics, by a committee convened by the British Plastics Federation; Post-War Building Studies No. 3; His Majesty's Stationery Office, London, 1944; 48 pages, 1*s.*; British Information Services, New York, $0.30.

This booklet, issued by the British Plastics Federation, summarizes the development and many present and prospective uses of plastic materials. It gives the results of an intensive study designed to stimulate the use of all kinds of plastic material for postwar industrial applications. It describes the various types of plastic materials and the processes of their manufacture.

There is a comprehensive list of the applications of plastics to use in building and in manufacturing. Standardization is recommended. The conclusions and recommendations will be helpful to all those who plan to use plastics. The list of actual and potential applications of plastics of interest to industry indicates the broad scope of postwar plastic utilization.

Educators Guide to Free Films, compiled and edited by Mary Foley Horkheimer and John W. Differ; Educators Progress Service, Randolph, Wis., 1944; 192 pages, $3.00.

In the fourth annual edition of this guide, 2,165 films currently available for educational institutions are listed. Of these, 444 are of 16-mm. size, silent type; 1,185 are of 16-mm. size with sound; 206 are of 35-mm., silent; and 330 are of 35-mm. with sound. It is stated that there is now available for the free use of educational institutions a total of 3,598 reels of motion-picture film and 203 slide films.

The subject-matter arrangement of the guide follows largely the usual system found in state and city courses of study. Separate indexes listing the

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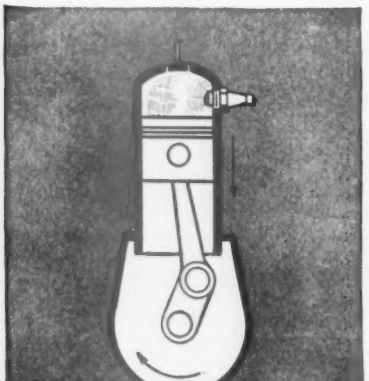

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titles, the sources from which the films can be obtained, and the classification by subjects facilitate the use of the guide.

Navy Yearbook, edited by Phillip Andrews and Leonard Engel; Duell, Sloan and Pearce, New York, 1944; 376 pages, $4.50.

This comprehensive reference book about the U.S. Navy and other navies will prove to be useful to all those who wish to have at their fingertips information about naval affairs.

Starting with a naval chronology of World War II and short descriptions of the various sections of the Navy and their work during the war, there follows a pictorial section that shows different types of our naval vessels and their auxiliaries. Much attention is given to naval aviation, both in the text and pictures. Aircraft carriers are given a prominent place among the first-line combat ships, and the various kinds of naval aircraft are featured.

The better known ships of the British, Russian, French, Italian, German, and Japanese navies are shown. In the data section will be found not only the essential information about battleships, cruisers, destroyers, etc., but detailed descriptions of combatant types of aircraft carriers, the escort type of carrier, the training types, and the aircraft auxiliaries. Details of the leading naval aircraft are also given. Similar information is given for the navies of the countries named, insofar as data are available.

The book will be a useful guide to all naval activities and contains reference material and essential information that will be helpful in following the successes of naval action during the war.

Electronics, Today and Tomorrow, by John Mills; D. Van Nostrand Company, Inc., New York, 1944; 178 pages, $2.25.

Basic information about the science of electronics is given in a textbook written in popular language. It contains explanations of electrons, electron phenomena, electron tubes, and electronic devices, in an order progressing from the elementary stage to the more complicated phases of the subject.

The author has omitted all reference to the military applications of electronics, and has confined the discussion of physics and electricity to the immediate necessities of an understanding of their relationship to the essentials of the art.

Manpower: The Story of Britain's Mobilisation for War, prepared for the Ministry of Labour and National Service by the Ministry of Information; His Majesty's Stationery Office, London, 1944; 60 pages, 9*d*.

How England mobilized its man power for service in the war effort is told in this pamphlet. Britain put every able-bodied citizen into war production, making certain that each citizen gave the fullest possible contribution to the national effort, but guarding individual rights and freedom to the maximum practical extent.

Engineering Materials Annual, 1944, edited by H. H. Jackson; Paul Elek (Publishers) Ltd., London, 1944; 108 pages, 8*s*. 6*d*.

Engineering Production Annual, 1944, edited by H. H. Jackson; Paul Elek (Publishers) Ltd., London, 1944; 102 pages, 8*s*. 6*d*.

These two volumes constitute part of a series intended to review important research work carried out during the past year or so. The information is taken from articles, bulletins, lectures, etc. Each chapter is written by a specialist. A bibliography accompanying each chapter gives references for further information.

Engineering Materials, 1944, deals with iron and steel, nonferrous metals, precious metals, natural and synthetic rubbers, ceramics, glass, refractories, plastics, lubricating oils and greases, solid fuels, gaseous fuels, plywoods, and adhesives.

Engineering Production, 1944, is devoted to machine tools, deep drawing and pressing, surface protection, surface hardening, hard facing, soldering and brazing, powder metallurgy, cutting tools, cutting oils and compounds, welding, bearing metals, inspection methods, and quality control.

Attack From the Air, by Air Commodore A. W. F. Glenny; Todd Publishing Company, London, 1943; 63 pages, 3*s*. 6*d*.

Many persons are asking why the bombing of Germany has not brought the victory so many air enthusiastics believed to be possible through air power alone. This book tells how the air forces have had to be used for so many other purposes that there could not be many 1,000-bomber attacks. The submarine menace took a large part of the equipment of the R.A.F. The African campaign required much more. The transport services needed thousands of cargo aircraft.

The conclusion of the argument is that, if all the manufacturing facilities of England and the United States could have been used for the building of bombers, victory would have been achieved by air alone. As the Commander in Chief of the Bomber Command said in the summer of 1942, "If I could put 20,000 bombers over Germany tonight, she would not be in the war tomorrow. If I could put 1,000 bombers over that country each operational night, it would be out of the war by autumn."

Sparring with the Weather, by Robert N. Buck; Aero Insurance Underwriters, New York, 1944; 60 pages.

A pamphlet containing information for pilots about how to combat the hazards of thunderstorms and icing. The text matter is reprinted from a series of articles by the author, which appeared in the magazine *Air Facts*.

The Men Who Fly, by Hector Hawton; Thomas Nelson and Sons Ltd., London, 1944; 165 pages, 5*s*.

This is a book on the life of R.A.F. pilots, their mental outlook, their work, and their teammates in their crews.

The author knows his subjects from close association and has written about them in a style that will give the reader a close-up of the great service they are rendering in winning the war.

The book is not only a scientific study of the airmen; it is replete with human interest.

The Science of Clocks and Watches, by A. L. Rawlings; Pitman Publishing Corporation, New York, 1944; 236 pages, $3.50.

The scientific principles of horology are set forth in this book. Considerable descriptive matter concerning clocks, watches, and the measurement of time is also included. Elementary mathematical demonstrations are introduced where necessary.

The author is a British specialist in instruments of various types. He describes the different kinds of clocks and watches and their important components, and gives advice on the selection of a watch or clock.

Triumph Over Tunisia, by Wing Comdr. T. H. Wisdom; George Allen & Unwin Ltd., London, 1944; 202 pages, 8*s*. 6*d*.

An R.A.F. Wing Commander, who was an active participant in the North African campaign, tells the story of the great victory over Rommel from an airman's point of view. He follows the R.A.F. from the preparatory work at Dieppe to the landing at Casablanca and Oran. He gives a highly personalized account of the work of the R.A.F. and the A.A.F. all through the winter until the Germans were finally driven out of Africa.

Side lights on many of the famous pilots and commanders, including General Doolittle, make the book a most interesting story of one of the great achievements of air power.

One-Man Air Force, by Capt. Don S. Gentile as told to Ira Wolfert; L. B. Fischer Publishing Corporation, New York, 1944; 55 pages, $1.25.

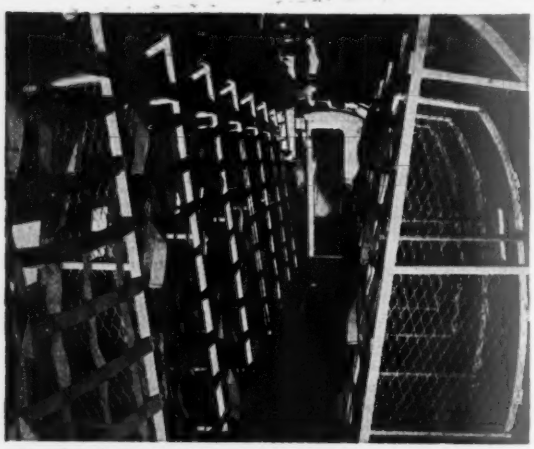
How a boy who bought a used Aerosport for $450 at Piqua, Ohio, learned to fly, and kept flying until he became one of the most famous aces of the A.A.F., is the background of this book.

It is Don Gentile's story, told in his own words. Believing that he did not have the educational background to enter the American service, he joined the R.A.F. in Canada. He flew Spitfires and, later, Mustangs and Thunderbolts. He shot down 30 enemy aircraft.

The book, which can be read in an hour, will show many readers how a typical American boy can achieve great success, win many honors, and still come back a modest hero.

Rotary Wing Development, by James A. J. Bennett; Semi Technical Bulletin Number 1; The American Helicopter, Inc., Bridgeport, Conn., 1944; 17 pages, $0.50.

The first of a series of semitechnical bulletins disseminating information about the helicopter. In this bulletin it is explained why the autogiro was de-



Interior of an Airfreighter. Tubular articles up to 12 feet long and bulk articles up to 26 x 36 x 72 inches can be handled.

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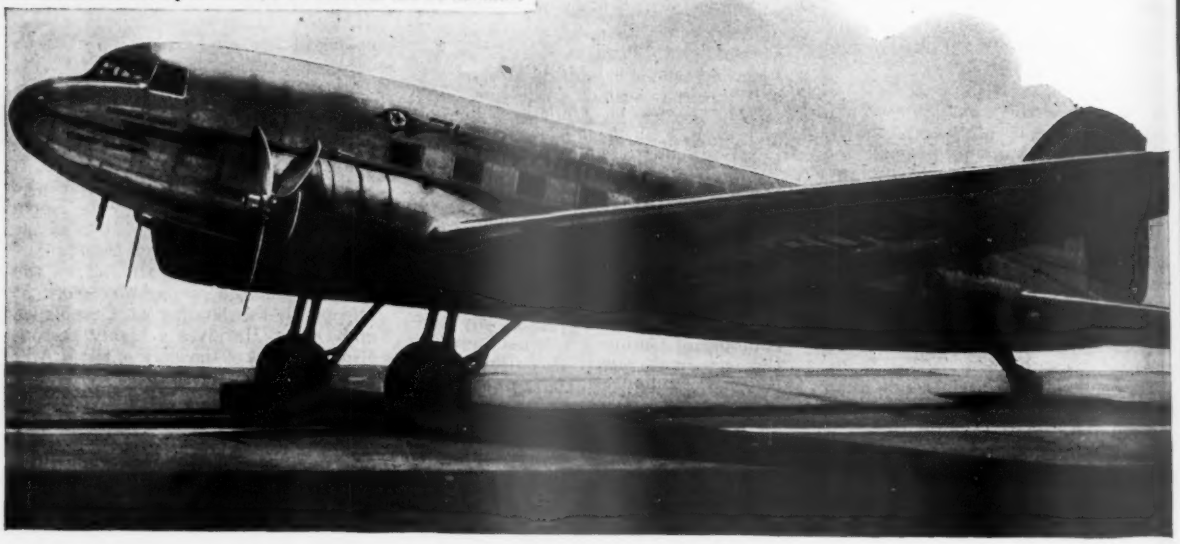

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veloped before the helicopter, although the latter's principles were discovered first. Fundamentals of autorotation, flapping and feathering, gyroscopic and coriolis effects, starting the rotor, direct control, direct take-off, and the powered rotor are outlined. In addition to alternative methods of balancing rotor torque, the bulletin contains discussions of design limitation and alternative arrangements. It also traces some of the prewar performance records established by helicopters.

Valley of the Sky, by Hobert Douglas Skidmore; Houghton Mifflin Company, Boston, 1944; 169 pages, $2.00.

This novel is outstanding because of the intimate knowledge the author has of air combat and his exceedingly interesting method of presenting the thoughts and actions of the crew of a Liberator during a South Pacific operation.

The story reveals the background of each officer and member of the crew by "flash backs" during operational flights, so that the reader not only follows their life aboard the bomber but knows what is going on in their minds.

The author, a staff sergeant who spent 16 months in the Pacific area, knows Air Force personnel, their habits, their language, and their outlook on life and death. In unfolding the story of the "Harpie," he brings the reader close to the human side of a bombing group.

As John Dos Passos, the well-known novelist, wrote: "It's the first book I've read about our part in this war that gave me the feeling of being written from the inside." Written during close contact with sorties in the combat area, the book reflects the emotions and attitudes of men who are going through experiences with danger present at all times. As an interpretation of the inner consciousness of pilots and their associates, the novel is brilliant as well as informative.

Aids to Technical Writing, by Richard C. Jordan and Marion J. Edwards; Bulletin No. 21, University of Minnesota, Engineering Experiment Station, Minneapolis, 1944; 117 pages, $0.50.

This guide for technical writers will prove extremely helpful to editors and publishers if the instructive suggestions are followed by engineers who prepare papers for publication.

Most authors have no idea of the printing problems involved in the proofreading and laying out of their manuscripts. This booklet gives information about the preparation of the manuscript and its illustrations so that the best results can be obtained. There are chapters on style, footnotes, tables, letter symbols, abbreviations, etc.

Because of its practical usefulness, the AERONAUTICAL ENGINEERING REVIEW makes an exception to its usual rule and strongly recommends that every writer of technical articles secure a copy and follow, in general, its directions when preparing his paper for publication.

Pacific Victory, 1945, by Joseph Driscoll; J. B. Lippincott Company, New York, 1944; 297 pages, $3.00.

This is a different type of war book. It deals with personalities, morale, customs, and habits of United States military and naval officers and of the Pacific-area natives they are encountering. It reads like the tale of a friend just back from the East who wants to give you the "low down" about what is going on.

Outstanding in the personal sketches are those of Rear Admiral Mitscher, Mrs. Roosevelt, and the Roosevelt family.

Probably the most interesting part of the book is that describing life on the islands, with special chapters on drinking and profanity. There is a revealing chapter on the state of mind of the Australians toward the United States soldier which does not promise too cordial postwar relations. The book is readable and provocative.

How to Select Foremen and Supervisors, by R. C. Oberdahn; National Foremen's Institute, Inc., New York, 1944; 53 pages, $2.00.

A book written for the primary purpose of aiding personnel managers and the heads of industrial relations departments in formulating a selection program for foremen. The text is also intended for workers and supervisors who wish to make an analysis of themselves for guidance purposes. The duties of a foreman are defined and modern methods of selecting foremen are set forth.

Hitler's Generals, by W. E. Hart; Doubleday, Doran & Company, Inc., New York, 1944; 222 pages, $2.75.

Nine of the leading German generals are studied in this informative book about the enemy leaders in this war. The most interesting biographical sketch of the nine, to those in aviation, will be the sketch of the life of Field Marshal Erhard Milch. The reader follows the leadership of this former managing director of the Deutsche Lufthansa through all grades of the German Army and Luftwaffe to the post of Secretary of State for Air under Goering.

He had much to do with reorganizing the Italian Regia Aeronautica and the Japanese Air Force. Through successes and reverses Milch has seemed to be able to hold his leadership and evade being the victim of intrigue. Included in this sketch is the story of the execution of Ernst Udet, the great German pilot.

Until the war is over when the true facts about the leadership of the German generals will be known, this book will serve as an excellent source of information.

Eight-Place Table of Trigonometric Functions for Every Sexagesimal Second of the Quadrant, by J. Peters; Verlag des Reichsamts fuer Landesaufnahme, Berlin, 1939; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1943; 901 pages, $20.

This eight-place table taken from a German book titled *Achstellige Tafel der trigonometrischen Funktionen fuer jede Sexagesimalsekunde des Quadranten,* contains trigonometric functions for every $^1/_{60}$ sec. of the 90° quadrant. The author has based the calculations on the tables of Andoyer, which give trigonometric functions for every 10 sec. of the arc of the 90° quadrant. From these tables every fifth value of the functions sine, cosine, tangent, and secant was taken to twelve decimals. The values were checked by differencing to the fourth difference, and 49 new values were interpolated between each consecutive pair of original values.

Because of the large number of figures assigned to each page it became necessary to separate the first three decimals and give them at the top and bottom of each column. When these separated leading groups differ at the head and foot of a column, one of them, together with its corresponding following groups, is distinguished by an asterisk. Leading values marked with an asterisk must always be combined with following values similarly marked, and vice versa. To facilitate the forming of the differences of consecutive entries, the largest and the smallest difference in each column is given at the top or bottom of that column. Thus, in general, the difference between any two consecutive function values is easily formed by glancing at the end figures of the values, since every difference in the column must lie between the values given in the difference lines at the top and bottom of the column.

Germany Will Try It Again, by Sigrid Schultz; Reynal and Hitchcock, New York, 1944; 238 pages, $2.50.

The author spent many years as a correspondent of the *Chicago Tribune* in Germany. In this book she writes revealing, interesting impressions of the development of the Nazi party, with sidelights on the men who were prominent in Germany from then until now.

Her account of how the German aircraft industry kept active after the prohibitive Versailles Treaty by establishing factories in Russia, Sweden, Switzerland, and Denmark shows how the evasions kept the aircraft development of Germany alive.

Brazil on the March, by Morris Llewellyn Cooke; Whittlesey House, McGraw-Hill Book Company, Inc., New York, 1944; 303 pages, $3.00.

The American Technical Mission, headed by the author, made a comprehensive study of the industrial development of Brazil. The survey includes transportation, fuel, electric power, mines, factories, and future manufacturing possibilities.

The members of the mission believe that there are great opportunities for air-cargo and glider operations in addition to passenger air transport. They give an analysis of the transportation

(*Continued on page 207*)

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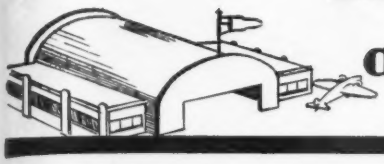

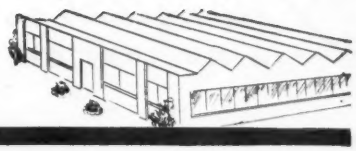

Aircraft Company's War Service

Boeing's Role in the War. Activities for the year 1943 are reported in a 160-page pamphlet. The record pertains to manufacturing, engineering, and cost reduction accomplishments of the Seattle, Wichita, and Renton divisions. *Boeing Aircraft Company.*

Wall Chart for Connectors

Cannon Type K Wall Chart. A one-page leaflet is available about the Cannon Type K and RK wall chart. Listed as chart Number 3, this chart is intended for use with the Company's Type K and RK Connectors. Its overall size is 38 in. by 50 in. *Cannon Electric Development Company,* Los Angeles.

Ordnance Assembly

The Gun Mounts Keep Rolling Along. Operating procedures of the Assembly Department of Bell Aircraft Corporation's Ordnance Division are outlined. Brief notes tell how on one line the elevator-vane assemblies are built and tested, on a second subassemblies and main assemblies are handled for certain types of gun mounts, on a third a different type of mount is assembled; a fourth line is devoted to back guards on one side and to vane and feed unit assemblies on the other; the last line is used in the assembly of spare parts such as ammunition boxes, ring and bead sights, etc. *The Bellringer,* September, 1944.

Self-Sealed Ball-Bearing Improvements

Three More "New Departures." In a four-page leaflet information is given about some new developments in self-sealed ball bearings. The first is a new, more efficient seal, adapted to a wider range of operating conditions. The second is a method for revitalizing the used lubricant in the bearing. The third is a new, extra-light sealed bearing. *New Departure Division, General Motors Corporation,* Bristol, Conn.

Negotiating Ryan Contracts

The Story of Contract Administration. This is the concluding article of three on the Contract Administration Department of the Ryan Aeronautical Company. Article number three deals with the functions of the Automotive Service and Officer Service divisions of the Department. It outlines the various activities of these divisions and tells about the people who work in them. *Ryan Flying Reporter,* August 11, 1944.

Vulcanized-Fiber Data

A six-page compilation of information to facilitate the correct specification of both phenol-fiber and vulcanized-fiber in parts fabrication is offered. Containing information about the properties and characteristics pertaining to each material, this brochure includes a listing of standard grades, tables governing electrical and mechanical strength, moisture absorption, etc. Engineers, designers, and manufacturers should find it a useful guide for determining the advantages as well as the limitations of fiber products for their particular applications. *N. S. Baer Company,* Hillside, N. J.

New Publication for Teachers

Air Age Education News. This is Vol. 1, No. I, of a publication to be issued by the organization established by American Airlines, Inc., to assist teachers and school administrators with educational programs in aviation. This first issue offers brief information about the men responsible for the direction of the organization and the objective of the undertaking. It also reviews and lists materials for classroom use. *Air Education Research,* New York.

Airports for Personal Flying

An Airport for Your Community. Advice is given about starting, selecting, constructing, and putting into operation a simple landing strip. The type of landing facility with which this booklet is concerned is one suitable for a small community and costing a nominal amount, but which can be expanded into a larger and better facility when future air traffic warrants such expansion. *The Pure Oil Company.*

Cowl Fabrication

Fabricating the Primary Engine Cowl of the Thunderbolt. A series of ten photographs depict production processes involved in manufacturing the primary engine cowl of the Republic P-47 Thunderbolt. The illustrated operations are those used by the Aluminum Cooking Utensil Company, subcontractors to Republic for the cowl. *Aluminum News-Letter,* August, 1944.

Antifriction Bearings

Hyatt Folks and Hyatt Bearings is the title of a booklet containing a picture record of how the company's employees and the bearings they make are helping to win the war. One section describes the activities of the company in the manufacture of antifriction bearings for aircraft engines. *Hyatt Bearings Division, General Motors Corporation,* Harrison, N.J.

Flight Dispatcher

Those Nerve Center Guys. Ray Connors. The duties of an air-line's flight dispatcher are outlined. Information is also given about the procedure in becoming a flight dispatcher and the phases of air-line operations in which a dispatcher must be schooled. *PCA News,* September, 1944.

Manufacturing Electrical and Industrial Machinery

Allis-Chalmers 1943 Annual Review and Preview. This report of Allis-Chalmers' activities for the year 1943 contains a summary of the latest developments affecting the company's products and processes. It is interpreted in terms of the industries served by this manufacturer of electrical and industrial machinery. The seven sections of the review are titled: "Power (Generation)," "Power (Distribution)," "Processing," "General Industrial," "Construction and Agriculture," "Transportation," and "Research." *Allis-Chalmers Manufacturing Company,* Milwaukee.

Small Tool Care

The Use and Care of Small Tools. Frank Bloomhorst. Suggestions are given on maintenance and handling procedures for small hand tools. Advice is offered about obtaining maximum efficiency from and prolonging the usefulness of cutting tools, drill motors, files, and taps. *Timm Topics,* August, 1944.

Adhesives and Coatings Catalogue

Catalog of Adhesives, Coatings, Primers, and Sealing Compounds. Cements, coatings, primers, putty, sealants, and spreads manufactured by The B. F. Goodrich Company for the aircraft industry are listed in this catalogue. The materials described are designed to meet the requirements of aircraft manufacturers, commercial air lines, and, in certain instances, U.S. Government specifications. They are indexed in five separate sections of the catalogue: the first tells about the nonvulcanizing cements; the second about the vulcanizing cements; the third about coatings and spreads; the fourth about sealants;

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Thus in SEXTANTS, too, Fairchild leadership stems from its development policy of engineering from bedrock, and supplementing *sound design* with *precise manufacture* and *craftsmanship*. Look for many of these Fairchild developments . . . optical as well as electronic . . . to find widespread industrial application when "tomorrow" comes.

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and the fifth about primers and accelerators. *The B. F. Goodrich Company*, Aeronautical Division.

Airport Operations

Sold . . . to the Army. The functions of Bell Aircraft's Airport Operations section are described. Information is given about the routines by which this section checks Bell airplanes to see that they are completely equipped and mechanically perfect before they are ready for delivery to A.A.F. Ferry Command pilots. *The Bellringer*, September, 1944.

New Catalogue on Potentiometers

Wenner Thermocouple Potentiometer. This is a 12-page, revised edition of a publication describing an instrument for the highly precise measurement of low voltages. It tells of the basic advantages that the potentiometer makes available and discusses the Wenner principle underlying the instrument design. Information is given about the mechanical construction, including a description of important details that help to minimize and compensate for error resulting from parasitic emfs. Photographs and schematic drawings show more clearly the chief characteristics and advantages of this wide-range potentiometer. Catalog E-33A(1) *Leeds and Northrup Company*, Philadelphia.

Hydraulic Wing and Nose Jack

Easy Does It . . . With New Jack. Details are given on the 10-ton hydraulic wing and nose jack developed by the Lockheed Customer Service for aircraft-maintenance operations. Advantages claimed for the device are that it is lightweight, portable, and collapsible to small size. Features of the hydraulic unit include a concealed release valve that is easily accessible; a pressure blow-off valve that precludes overloading; dual fast-action high- and low-pressure hand pumps; pressure and suction valves that are reached easily without dismantling the jack; pressure port in jack base for a gauge or dial; threaded ram with high-speed locking nut; 20-in. high extension adaptor that screws on top of ram. *Lockheed Global Service Log*, Second Quarter, 1944.

Aids for Selection of Instrument Transformers

Instrument Transformer Accuracy Standards is a two-part booklet of 56 pages. The first part explains the A.S.A. accuracy standards for potential and current transformers and shows how they differ from the N.E.M.A. standards. Several tables and graphs simplify the use of Part I in respect to classifying transformers for accuracy, evaluating the effects of transformer errors on meter readings, and explaining the significance of accuracy classes and burdens.

The second part of the booklet consists primarily of a guide for the selection of standard indoor and outdoor current and potential transformers. It contains approximately 60 illustrations of the transformers, with prices, ratings, and A.S.A. and N.E.M.A. accuracy classifications for each type. *General Electric Company.*

Pressure Units

A recently issued circular describes the Bar-Lok quick-acting pressure unit. This unit is designed for applications where speedy clamping and unclamping in repetitive operations can improve the efficiency of machining, welding, assembly, or positioning. Adaptable for both medium and heavy duty, it incorporates quick adjustment and firm holding against vibration in jig and fixture work.

The unit consists of a radially grooved pressure bar inserted through a threaded pressure collar and provided with a suitable handle and foot. The entire unit is placed in the fixture through a threaded hole in the wall or riser. By advancing the pressure bar to make contact with the work and turning the handle slightly to the right, the clamping pressure is quickly applied. *Mechanics Engineer Company*, Jackson, Mich.

Steamship Companies Apply for Overseas Air Routes

Statement of Policy on Overseas Aviation. On behalf of American steamship companies who have applied to the C.A.B. for certificates authorizing them to inaugurate overseas air service, a statement of policy is issued. The case for the applicant companies is outlined under twelve points. These points are headed: (1) Competition; (2) Number of Services on a Given Route; (3) Area to be Served; (4) Service to Internal U.S. Points; (5) The Question of Discrimination; (6) Effect Upon the American Merchant Marine; (7) The National Defense; (8) The "Separation" Theory; (9) Clarifying Legislation; (10) Difference Between Overseas and Internal Transport; (11) Development of Air Transport; (12) Why a Coordinated Sea-Air Service? *National Federation of American Shipping*, Washington, D.C.

Manufacturers of Precision Parts

Thompson Products: A Decade of Achievement. A 52-page booklet traces the progress of Thompson Products, Inc., since 1933. It describes the company's products, facilities, and growth. It tells of the conditions under which employees work, and reports on the financial earnings of the firm. It also contains information about Thompson's plans for the years following the war. *Thompson Products, Inc.*

Supplement for Cannon Type AN Bulletins

AN Supplement. A fourth edition of the AN Supplement is now ready for all holders of Cannon Type AN bulletins. It includes new tooling data on current insert arrangements, new coupling nut and assembly designs, 37 new insert arrangements, additional bulletins for special AN connectors and the new type AN3101, and production illustrations of AN3108 parts. Dated May, 1944, the new AN supplement replaces the one issued in November, 1943, numbered pages 20-A to 20-J. The new supplement pages are numbered 20-1 to 20-24, inclusive. *Cannon Electric Development Company*, Los Angeles.

Future Glider Developments

The Future of Motorless Flight. Wm. Gus Briegleb. Some general comments are made on the performance of gliders in military operations and the future of the glider in the postwar period. It is stated that when it is no longer necessary for reasons of military security to hold back the facts, it will be learned that the glider played a much more important part in the winning of the war than is now appreciated. A study of the results obtained with high-performance sailplanes and converted planes indicates that for efficient operation at speeds above 100 m.p.h. the glider must be of clean design. It is predicted that future gliders for the transportation of men and materials will be much more efficient. The importance of providing glider centers throughout the country, to educate laymen and school authorities in the use of motorless craft, is emphasized. *The Thermal*, September, 1944.

Rubber Products for Industrial Applications

Industrial Rubber Products. Produced especially for designers of industrial equipment as well as consumer products, a general booklet has been issued about the industrial rubber products of The B. F. Goodrich Company. Included in the booklet are discussions of the company's line of Vibro-Insulators, devices of rubber and metal that reduce vibration; molded, extruded, lathe-cut, and sponge-rubber products; rubber-lined tanks and valves; products made with Koroseal, flexible material created from plasticized polyvinyl chloride; V-belts; and cements. *The B. F. Goodrich Company.*

Marking Devices

Information about marking devices is contained in a four-page bulletin. Descriptions and illustrations pertain to roller dies, die inserts, special type and type holder, a special holder for embossing type, steel stamps, steel letters and figures, and a group of standard stock symbols. A size chart is included. *Marquette Engraving and Manufacturing Company*, Chicago.

Cleaning and Greasing Tool

Bearing Down on Service Costs. The construction and operation of a cleaning and greasing tool for aircraft bearings are described. Developed by Lockheed's Service Division, this device is simple and inexpensive, and enables the prolonged use of bearings that formerly would have been discarded because of dirt. *Lockheed Global Service Log*, Second Quarter, 1944.

Electrical Test Laboratory

Performance Probers. This article contains data on the facilities of the Research Engineering Department's Electrical Test Laboratory at Bell Aircraft's Niagara Division. It tells how every phase of the plane's electrical system can be studied through the use of electrical mock-ups connected to the main test-panel board. Among the features of the laboratory to which attention is called are the power supply and a variable-speed driving unit for studying generator performance and running tests on various engine-driven auxiliaries. *The Bellringer*, August, 1944.

Air Mail Society Members Listed

American Air Mail Society Directory. This directory contains two lists—one is an alphabetical arrangement of the names of the Society's members; the other is a geographical roster. The names of officers and all active members are included, as well as the addresses of the branch chapters. *American Air Mail Society, Inc.*

Velocity Polar Curves

Distance by Cross-Country Polar. Stan Hall. This article discusses the velocity polar curve, which, it is explained, is a representation in graph form of the relation between the sinking speed and forward speed of a glider along the flight path. The writer describes how a pilot can construct such a curve for his particular sailplane, convert it for use as a cross-country polar, and use it in flight. *The Thermal*, September, 1944.

16 Years in the Aircraft Business

Since 1928 . . . Builders of Fine Aircraft. A pictorial review of the Spartan Aircraft Company's progress and achievements is presented in booklet form. The booklet lists various planes that have been built by the manufacturing division of the company, tells something of its management, describes its facilities, and indicates its future plans. It also describes the activities of the Spartan School of Aeronautics and contains an account of the work done by the Spartan Aero Repair division. *Spartan Aircraft Company*, Tulsa, Okla.

Bonding Metal to Metal

New Metal-to-Metal and Metal-to-Wood Adhesive Announced. Information is given about a process for "gluing" metals, which is stated to produce strong joints that are more efficient aerodynamically than those obtained with rivets. It is explained that the process, known as Redux, is based on the use of two separate components, a powder and a liquid. Operations involved in bonding metal to metal are described. Other sections discuss the shear values obtained, resistance to exposure, metal-to-wood applications, and lap joints. *The Resinous Reporter*, July, 1944.

New Industrial Newsletter

Profilometer Comments is the name of a newsletter which is planned to appear bimonthly.

The first issue of the new volume includes articles about the operation of the Profilometer for measuring surface roughness; descriptions of Profilometer accessories and company services; and "kinks" and ideas on the use of the Profilometer.

The new publication is issued in standard $8^1/_2$-in. by 11-in. page size, contains four pages, and is well illustrated. Each issue is punched for insertion in a binder which is furnished to those who wish to maintain a complete file. *Physicists Research Company*, Ann Arbor, Mich.

South Atlantic Island Base

Too Lonely for Napoleon's Exile. An account of how the U.S. Air Transport Command established a base on deserted Ascension Island in the South Atlantic. Outlining the problems that complicated the project, the article relates the difficulties of building the runway on rock and tells of the menace to planes encountered in the form of great flocks of terns. *Lockheed Global Service Log*, Second Quarter, 1944.

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New Oakite Cleaning Manual for Aircraft Plants

Covering all important phases of production cleaning in aircraft manufacture, including techniques for removing oxide film, rust and scale, this enlarged second edition of the NEW Oakite Aviation Manual describes war-proved methods for expediting more than 30 different types of work and operations.

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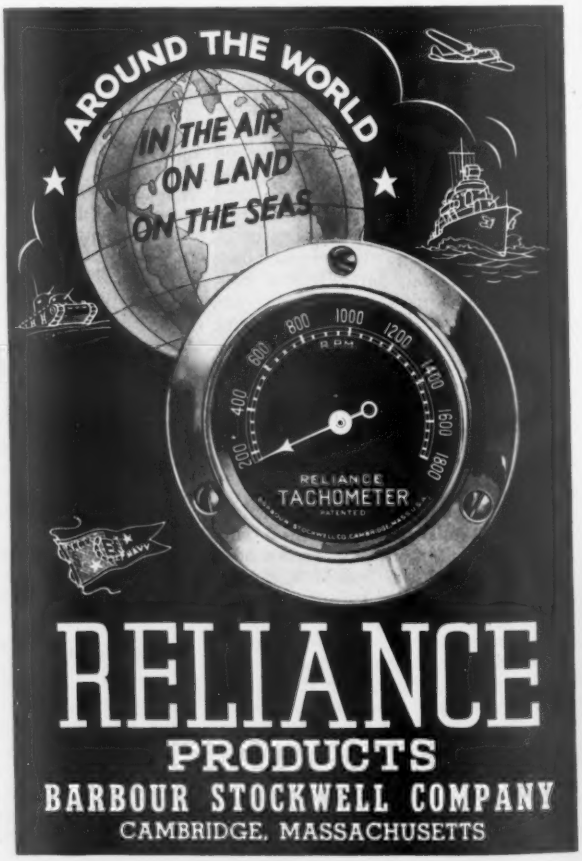

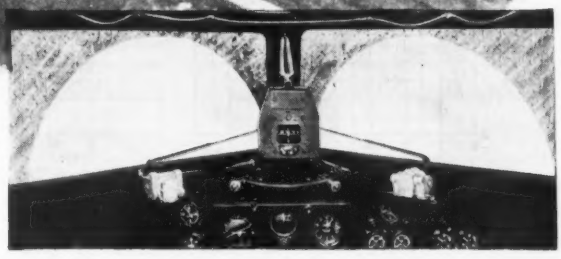

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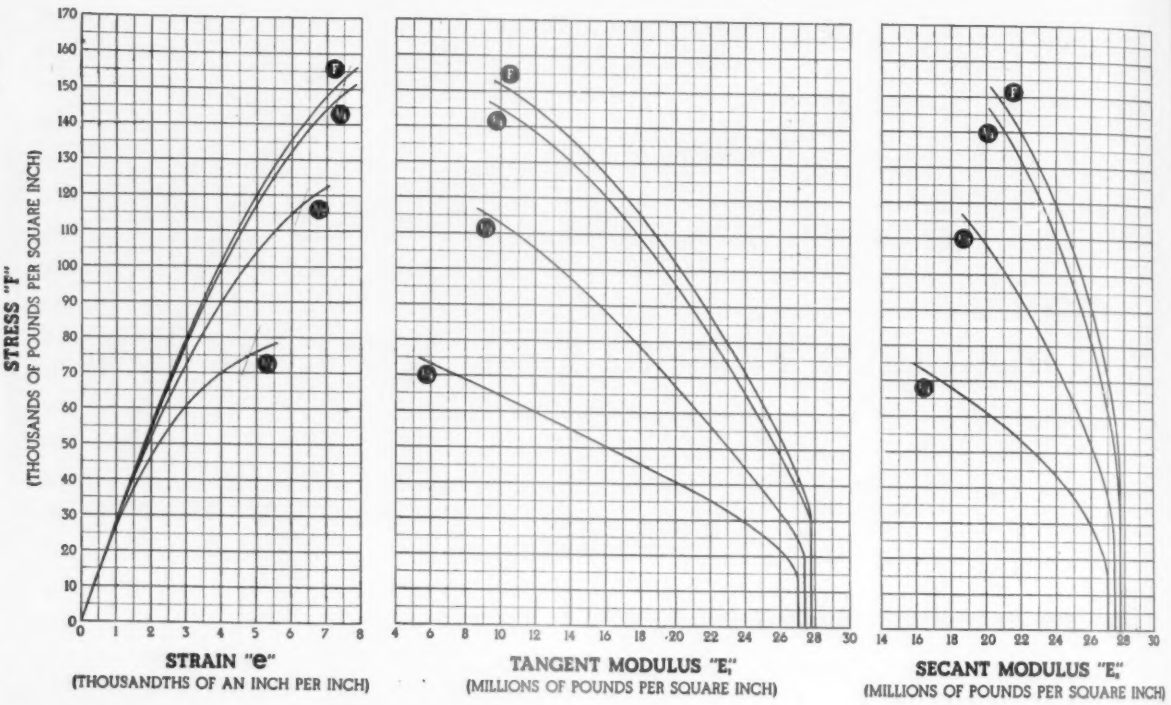
What the Design Engineer Should Know

ABOUT HIGH TENSILE STAINLESS


STRESS "F"
(THOUSANDS OF POUNDS PER SQUARE INCH)
STRAIN "e"
(THOUSANDTHS OF AN INCH PER INCH)
TANGENT MODULUS "Et"
(MILLIONS OF POUNDS PER SQUARE INCH)
SECANT MODULUS "Es"
(MILLIONS OF POUNDS PER SQUARE INCH)

These curves show the tensile properties of ARMCO High Tensile Stainless Steel Sheets from tests made on longitudinal specimens as cold rolled. They are reproduced from a practical new handbook that contains compression and tension values of high strength stainless for the complete useful range.

These data give the stress-analyst and designer the information needed to proportion stronger, lighter structural parts with *less* stainless. Construction of aircraft and other light-weight structures demands adequate knowledge of the compressive strengths that can be expected from the materials you use.

Besides the detailed values for stainless, the handbook covers some fundamental concepts of design theory to be considered when using stainless steels at the high stress levels where they are most effective. Mechanical properties of the stainless steels and derived design data are also included in the book.

		¼ Hard	½ Hard	¾ Hard	Full Hard
Ultimate Strength—thousands of lb. per sq. in.	F_{tu}	133	162	183	187
Yield Strength at 0.2% Offset—thousands of lb. per sq. in.	F_{ty}	75	117	147	153
Proportional Limit at 0.01% Offset—thousands of lb. per sq. in.	F_{tp}	35	49	59	61
Initial Modulus of Elasticity—millions of lb. per sq. in.	E_o	27.0	27.5	28.0	28.0
Elongation—per cent in 2 in.		46	37	31	29

If you are a designer of light-weight structures, write us on your company letterhead for a free copy of this handbook. It is titled: "Design Data on High Tensile Stainless Steel Sheets for Structural Purposes." You'll find it a valuable addition to your design manuals. The American Rolling Mill Company, 1991 Curtis Street, Middletown, Ohio.

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Manual for Instrument Overhaul

Pioneer Autosyn Instruments Overhaul Manual. A manual containing instructions for overhauling the instruments used in the Autosyn system of remote indication. The introduction gives a general description of the system, which is essentially an electrical method of transmitting the indications of mechanical instruments from the remote points at which they function to the instrument panel of the aircraft. Detailed service information is furnished for different types of indicators and transmitters. Service assembly drawings are included for each instrument type, showing all parts, and smaller drawings clarify the text. *Eclipse-Pioneer Division, Bendix Aviation Corporation.*

Rapid Welding Method

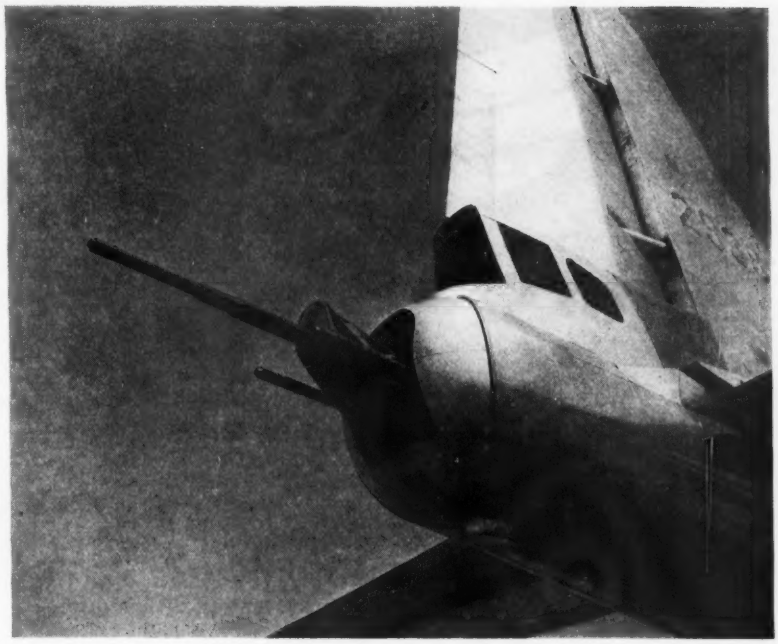
"Fleet-Welding." A new method for increasing the speed of welding mild steel, called "Fleet-Welding," is described in a 48-page booklet. This development is said to introduce a technique of arc welding that not only greatly increases the speed of the process over conventional welding methods, but also cuts costs as much as 59 per cent. Ways in which the process utilizes the benefits of "arc force" to obtain greater penetration and the required weld strength are explained.

Some of the subjects covered in the manual include: using arc force to increase welding speed; effect of penetration on welding costs; cost reduction with "Fleet-Welding"; factors affecting production speed, and general information and corrective suggestions pertinent to the procedures used for butt, fillet, and lap welds. Several pages are devoted to the procedures for welding 18-gauge to 10-gauge sheet metal, with tables giving electrode type and size, electrode polarity, current, arc speed, pounds of electrode per foot of weld, and recommended fit-up for butt welds, fillet welds, lap welds, corner welds, and edge welds. Procedure tables list plate thickness, electrode size, current, melt-off rate, arc speed, number of passes, feet of joint welded per hour, and pounds of electrode per foot of weld. *The Lincoln Electric Company,* Cleveland.

Future Airports for Civil Airplanes

Some Factors in the Design of Civil Land Aerodromes. Graham Dawbarn. The writer discusses some of the fundamentals of civil-airport design and offers his observations with regard to the trends that airport development will follow in the future. Besides referring to provisions contained in a British Air Ministry pamphlet called "Technical Characteristics of Aerodromes—Part I: Siting and Layout of Land Aerodromes," some of his comments pertain to the size of future airports, the number of directional runways, "saturation" and parallel runways, service and embarkation areas, refuelling areas, two-directional landings with parallel runways, the relation of future airplane-design development to airport design, and ground facilities for rotating-wing aircraft.

Summarized, his beliefs are that: (1) Few airports approaching the scale of a discussed airport for transoceanic service (which considerably exceeds in size the plans for Idlewild and Long Beach, Calif.) will be built; perhaps a dozen in the world, including four in North America and two in Great Britain. (2) Research will again be concentrated on developing aircraft and control equipment so as to limit the size of airports necessary for regular air transport over a limited range. (3) Fixed-wind transport aircraft will never (except as a stunt) land on buildings or other raised structures within large cities. (4) Rotating-wing aircraft will habitually land at city centers, probably at or near ground level, but possibly also on "rotor towers." Such towers would have windbreaks above the landing platform, garaging and servicing facilities immediately beneath, and offices farther below. (5) Attention will be increasingly turned to reducing the number of alternative runway directions. *The Intavia World,* May, 1944.



The tail turret of the Boeing B-29. Its two 0.50-cal. machine guns flank 20-mm. cannon. The gunner is located in the windowed compartment beneath the bomber's rudder.

List of Radio and Electronics Books

Allied's Radio and Electronics Book Guide. A booklet of 28 pages has been released which lists a wide selection of publications on radio, electronics, and related subjects. Listings range from the simplest fundamentals to advanced practices for beginner, student, radio amateur, instructor, technician, service and maintenance man, and engineer.

The listings are divided into two major parts: (1) a classified directory by subject (Aeronautics, Electricity, Engineering, Basic Training, etc.); (2) a listing under publisher, by author and title, with a brief summary of contents, size, number of pages, price, etc., of each book. *Allied Radio Corporation,* Chicago.

Electrical Harness Assembly Boards

Building the B-29's Electrical Harness Fast! Descriptive details are given about the special jigs that are used to speed assembly of the Superfortress' electrical harness. These jigs are in the form of boards, laid out in stations, which make possible a system of material allocation so that each worker has a specific task to do, a specific place to perform the task, and a specific time for its operation. It is claimed that, by means of these electrical harness boards, a job that formerly required several days is now completed in a few hours. *The Bellringer,* August, 1944.

Soluble Nitrocellulose Base for Plastics

Hercules Nitrocellulose Properties and Uses. A basic textbook on the properties and uses of soluble nitrocellulose as a base for plastics, lacquers, coated textiles, and many other products, has been published.

Beginning with a discussion of the history of nitrocellulose, the book continues with a section on properties which includes chapters on the manufacture, types, solubility, viscosity, and other pertinent information about this product. This section also contains six tables, including one showing nitrogen and viscosity specifications of the 17 Hercules soluble-nitrocellulose types, a nitrocellulose blending chart, and 22 other charts and graphs.

More output per pound . . .

with this line of 28.5-volt d-c generators for aircraft

Fighters and bombers need lots of electrical power—but they watch their weight like a beautiful woman.

Yet the design of electrical apparatus for aircraft must consider more than just weight reduction—there are factors of vibration, cooling, and brush wear that must be met.

The five d-c generators shown at right represent the range of Westinghouse units that are meeting this exacting service. Their weight-output ratio is exceptionally favorable.

FOR EXAMPLE:

TYPE	AMPERES	SPEED	WEIGHT
O-4	100	4000/8000 rpm	23 lbs.
O-1	100	2500/4500 rpm	33 lbs.
P-2	200	4000/8000 rpm	37 lbs.
P-1	200	2500/4500 rpm	44½ lbs.
R-1	300	4400/8800 rpm	48¼ lbs.

Westinghouse started in the aviation field in 1917, building the first wind-driven, high-frequency alternators for World War I aircraft radios. These 27 years of experience in designing and manufacturing electrical equipment for aircraft constitute a sound reason for making Westinghouse your working partner in aviation progress. Westinghouse Electric & Manufacturing Company, Small Motor Division, P.O. Box 868, Pittsburgh 30, Pa.

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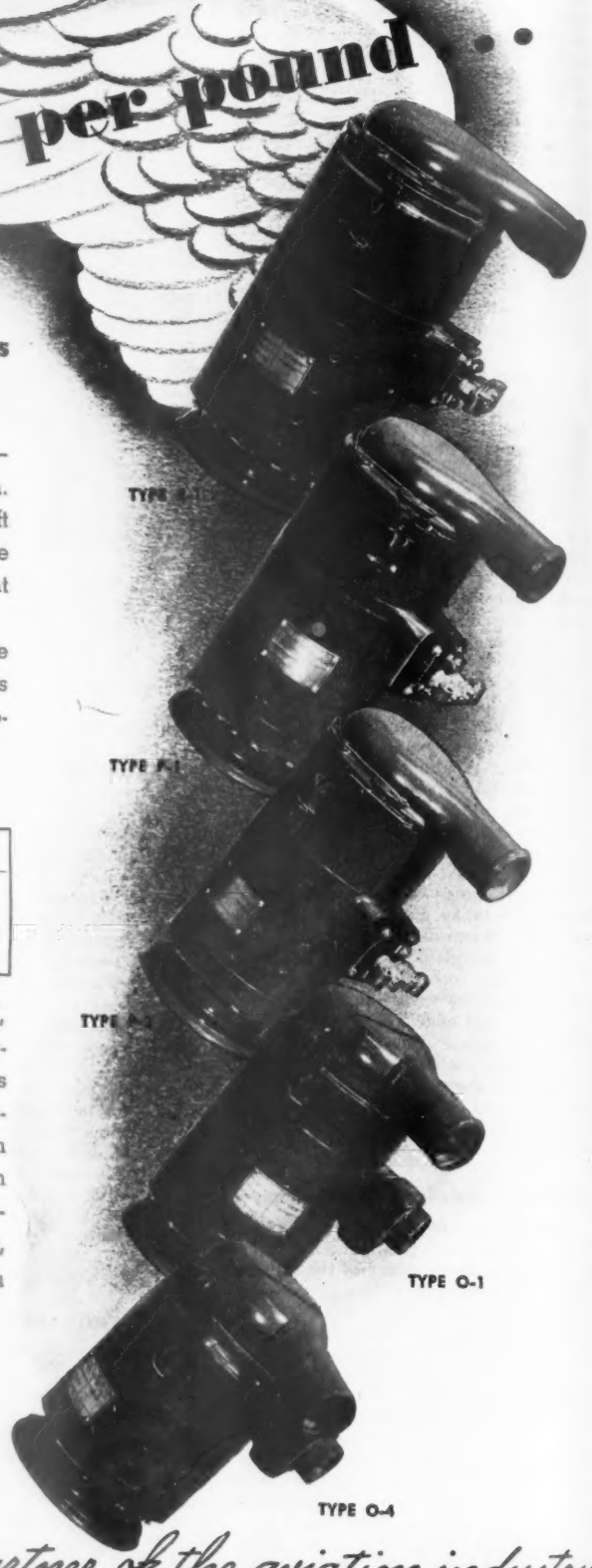


Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

for 27 years the electrical partner of the aviation industry

The second portion of the book deals with the uses of nitrocellulose and its application to lacquers, coated textiles, plastics, adhesives, and inks. Nine tables in this section show the harness of lacquer films, the results obtained from exposing lacquer panels to 3 and 6 months of weathering in Florida, exposure data on pigmented nitrocellulose-lacquer panels after 3 years' weathering in Wilmington, Del., the use of nitrocellulose in artificial leather and coated textiles, and typical properties of nitrocellulose plastics. *Hercules Powder Company, Cellulose Products Department*, Wilmington, Del.

Redesigned Instrument Panel

Putting New Punch in PV-1's. The U.S. Navy plane, PV-1, is now being equipped with a new instrument panel that provides the copilot with a complete set of flight instruments and permits him to relieve the pilot. This article describes the panel and tells of the design and engineering problems involved in its creation. Among the problems noted is that of using dual-reading instruments to obtain the needed space on the panel for additional instruments. Other reported problems concern the use of externally grounded temperature bulbs in place of internally grounded bulbs, the incorporation of a modification to the previous fuel system, and wire-numbering and coding systems that would not conflict with standard wiring yet would be readily associated with it. *Lockheed Global Service Log*, Second Quarter, 1944.

Tests for the Weldability of Alternate Aircraft Steels

Weldability Standards for Alternate Aircraft Steels. This booklet describes a series of tests which enable the weldability of proposed alternate steels to be compared with that of standard aircraft steels. The tentative standards are based on a research investigation of the problem covering both arc and gas welding, and the prescribed tests have been selected not only for their reliability but also for their ease of performance in the usual aircraft plant.

Included are the Tee-Bend Test; Transverse Butt-Joint Tension Test of $^1/_8$-in. Plate; Transverse Butt-Joint Tension Test of $^1/_8$-in. Sheet; Transverse Butt-Joint Tension Test of Tubing; and Welded Double-Tube Triangle Test. Test specifications include test-plate dimensions, filler-metal sizes, preheating and welding procedures, as well as the methods of testing. *American Welding Society.*

Pneumatic Tire Manual

Design and Construction of Pneumatic Tires. A comprehensive manual on the design and construction of pneumatic tires has been published for U.S. Army training schools and is now also available to civilians interested in the subject. Consisting of 50 illustrated pages, the manual discusses the basic principles of pneumatic tire design, including pictured descriptions of the role which each part of the tire plays in its operation, and how tires are manufactured.

Measurements and other data on each of the important classifications of heavy-duty military and civilian tires, and proposed load and inflation tables for them, are one of the features of the publication, together with tube, valve, flap, and rim data.

Although the information principally concerns tires for surface vehicles, many of the features of tire construction apply also to airplane tires. A chart gives the relative weights of materials in a typical airplane tire. *The B. F. Goodrich Company.*

The Impa Tu-Sa-No. 0

The Latest Argentine Light Aeroplane. Specifications and descriptive data are given for a prototype light airplane of Argentine design. The Tu-Sa-No. 0 is described as being entirely of wood construction. It is a low-wing cantilever monoplane with an enclosed cabin, seating two side-by-side, with dual controls. A curved windshield offers good forward view over the sloping nose. The simple, fixed landing gear incorporates two single shock-absorber struts attached to the extremities of the small rectangular center section, with struts and landing wheels enclosed in streamlined fairings. In its civil form, this light plane is powered by a Continental flat-four engine. However, a version of the Tu-Sa-No. 0, intended for the advanced training of military pilots, will have retractable landing gear and will be fitted with a 130-hp. de Havilland Gypsy Major engine. *The Intavia World*, May, 1944.

Pioneer Aircraft Instruments

Additional technical information has been released concerning Pioneer Aircraft Instruments. Bulletin No. 43-6 (superseding 22-4) is a pamphlet on direct-reading magnetic compasses; bulletin No. 46-22B (superseding 44-13B) is a current list of available publications about Pioneer Aircraft Instruments. There are three test procedure sheets—310-8A on autosyn indicators, 41-10 (superseding 37-5) on the magnesyn remote-indicating compass system, and 44-20 on standard manifold pressure gauges. Data sheet No. 46-15E refers to the tools and fixtures to be used in servicing autosyn fuel flowmeter transmitters. Three service bulletins complete the group; these are: 45-5, for the installation of retainer and screen assembly in the demand oxygen regulator; 43-20, for modifications for improved performance of the gyro flux gate compass amplifiers; and 43-22 (superseding 34-26F), for the gyro flux gate compass system. Four wall charts have also been made available. One gives instructions for the operation of the Pioneer gyro flux gate compass; another explains the demand oxygen regulator; and the third and fourth give operating instructions and detailed sectional drawings of the automatic-averaging sextant.

Handbook of Design Data on Stainless-Steel Sheets

Design Data on High Tensile Stainless Steel Sheets for Structural Purposes. A new handbook for designers of stainless-steel equipment contains information for accurately proportioning stronger, lighter aircraft and other equipment parts. Detailed values are compiled for commercial stainless sheets, both above and below the yield point. Test results and discussions deal with Armco high-tensile stainless-steel sheets in quarter, half, three-quarter, and full hard tempers.

Compression and tension data in the handbook establish minimum values for the designer. Some of the subjects dealt with include: mechanical properties of the stainless steels and derived design data; certain fundamental concepts of design theory to be considered when using stainless steels at high stresses where they are most effective; stress-strain data from tensile and compressive tests on high-strength stainless-steel sheets, both above and below the yield point; significance of the tangent and secant moduli of elasticity in structural design. *The American Rolling Mill Company*, Middletown, O.

Molding of Plywood Veneers

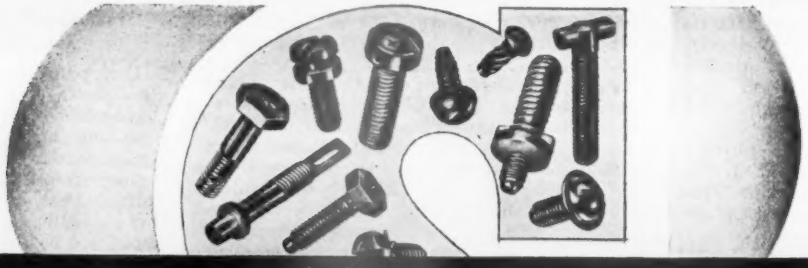
The Plymold Story. In this article a description of a method for molding plywood veneers is given, which is stated to produce precision-dimensioned parts for aircraft. It is explained that the material is produced by combining plywood veneers with Bakelite bonding resins, and then cross-laminating and molding over dies with controlled heat and pressure. Illustrations demonstrate how Plymold parts are manufactured at the plants of the Haskelite Manufacturing Company. *Bakelite Review*, July, 1944.

Forming Tools Made by Thermoplastic Casting

Tenite II Casting describes casting of a thermoplastic material for forming tools. The booklet has been issued for the benefit of tool engineers, and should be of particular interest to aircraft companies and other industries engaged in the forming of sheet metal.

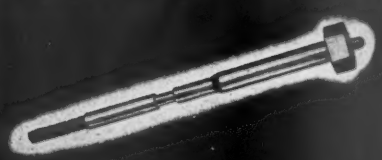
According to the booklet, plastic forming tools are preferred to metal ones in many cases because of their relatively low cost, timesaving, and lighter weight. The most pronounced advantage of plastic forming tools is to be seen in tool parts that must fit mating contours. The writer states that double-compound curves can be cast as easily and quickly as flat surfaces.

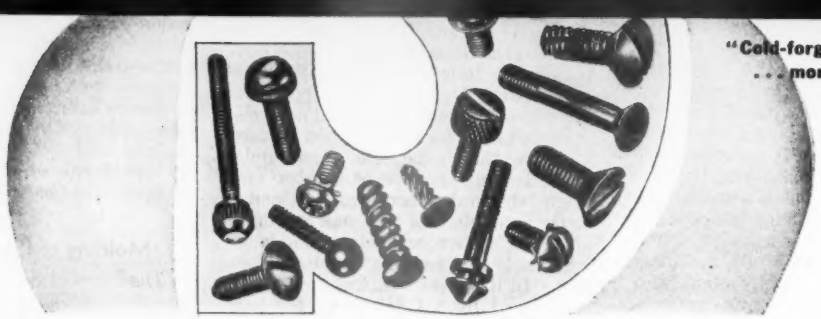
It is stated that forming tools such as drop-hammer punches and forces and draw rings for double-action draw presses are cast in Tenite II from the dies with which they are to be used. These tools are made by casting a molten plastic into or around finished shapes or models. The booklet gives a detailed description of the procedure to be followed in casting the material,



PLAN YOUR FASTENINGS NOW

For that Product in the Design Stage





"Cold-forging"—proof #24 . . . more each month

Plan now for fast assembly of your product before it leaves the design stage. Your preparation for postwar production should include an early and exacting choice of fastenings—standard or special—to eliminate unnecessary assembly problems later. Remember, your precise selection may be "the making" of your assembled product—for no product can be better than its fastenings.

Now is the time to let Scovill's broad experience in fastenings and skill in special design serve you. We will help you determine the best modern fastenings to use—one of our featured standard fastenings, or a part specially designed to fill your specific need.

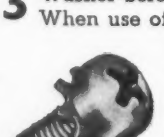
A substantial saving was effected by cold-forging the unusual part shown above. You likewise may profit through Scovill ingenuity in cold-forging . . . saving money—materials—motions. Call our nearest Fastenings Expert **now** for assistance in planning your fastenings.

3 Standard Fastenings for Production Efficiency

1 Phillips Recessed Head Screws—The modern, effective, time-saving fastening device proven in tens of thousands of assembly lines. Other standard head styles are available.

2 Self-Tapping Machine Screws—Eliminate separate tapping operations for fastenings to castings, heavy gauge sheet metal, and plastics. Also with Phillips Recessed Head.

3 Washer-Screw Assemblies—When use of lock washers is indicated, the time-saving of pre-assemblies is obvious. Also available in standard slotted head styles.



SCOVILL MANUFACTURING COMPANY

WATERVILLE SCREW PRODUCTS DIVISION

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NEW YORK, Chrysler Building . DETROIT, 714 Fisher Building . CHICAGO, 1229 W. Washington Boulevard . PHILADELPHIA, 18 W. Chelten Avenue Building
PITTSBURGH, 2882 W. Liberty Ave. . SYRACUSE, Syracuse-Kemper Insurance Bldg. . LOS ANGELES, 2627 S. Soto St. . SAN FRANCISCO, 434 Brannan St.

with specific reference to the casting of a drop-hammer punch.

Special advantages of Tenite II over other materials are listed as follows: it will form sheet metal into the corners of a die without becoming rounded as do lead and soft metal alloys; it can be cast to finished size in the die without the scraping and polishing that is necessary with metal punches; it has greater strength than other thermoplastics used for casting; it is relatively unaffected by temperature changes; the composition may easily be made harder or softer; a finished Tenite casting is easily machined. *Tennessee Eastman Corporation*, Kingsport, Tenn.

National Aircraft Standards

The following National Aircraft Standards have been issued: NAS 52, Electrical, shielded, flexible conduit or assembly, revision 1, dated May 11, 1944; NAS 159, Aircraft, internal wrenching bolt specification, approved May 10, 1944. *National Aircraft Standards Committee.*

Free Lessons With the Purchase of Every Air Liner

Making "D-Day" Airline Pay Day. The program of training offered for the personnel of air lines purchasing Lockheed transports is outlined. The predelivery instruction that is given to air crews and ground crews is explained. Courses for personnel of air lines equipped with Lockheed Constellations are divided into three major phases: service and maintenance of the airplane, flight engineering preparatory, and flight engineering. The customer's ground mechanics receive instruction in the first phase only; flight engineers are instructed in all three. There are also "check-out" courses for the customer's pilots, conducted during the production flight tests of the contracted airplane. *Lockheed Global Service Log*, Second Quarter, 1944.

Aircraft-Terminal Data

Tru-Loc Aircraft Terminals. A file-size booklet about Tru-Loc aircraft terminals contains data about swaged terminals and fittings for aircraft controls. Including specifications and descriptive details on ball-type swaged fittings, "quickies" for aircraft controls, center-pull loop fittings, and strap terminals, it supersedes all former folders on those items. The booklet also embodies a discussion of swaging problems and explanations of the causes of defective swaging. *American Chain & Cable Company, Inc., Automotive and Aircraft Division*, Bridgeport, Conn.

S.A.E. Aeronautical Material Specifications

Two new specifications and 15 revisions of former specifications have been published by the S.A.E. as of August 1, 1944. They include specifications on cadmium plating; aluminum sprayed metal finish; magnetic inspection; mica-base, antiseize compound; a high-temperature, oil-resisting gasket; magnesium-alloy castings, bronze strip; chromium molybdenum centrifugal steel castings; and steel carburizing. A revised price list and order blank has been issued also for all Aeronautical Material Specifications as of August 1, 1944. *Society of Automotive Engineers, Inc.*, New York.

Protective Spray Coatings

Packages From Spray Guns. A brief article tells how airplanes are "crated" for shipment overseas by spraying them with a practical plastic coating. It is stated that planes treated in this way are immune from attacks of heat, cold, sleet, and salt water. *Bakelite Review*, July, 1944.

New House Organ

Highways of the Air is to be published at intervals for free distribution to those interested in the promotion of the development of radio in aviation as an aid to the protection of life and property. The first issue, Volume I, Number 1 contains the following articles: "The Army Airways Communication System," by Lt. Walter W. Fawcett, Jr.; "Airway and Ground Facilities of the Future," by William A. M. Burden, Assistant Secretary of Commerce; and "Radio in Aviation," by Charles I. Stanton, Civil Aeronautics Administrator.

The concluding pages of the current issue contain the fifth reprint of a booklet originally published in 1935 under a title similar to the current house organ's, containing an explanation of radio navigation aids. *Radio Receptor Company, Inc.*, New York.

Spark-Plug Manual

Champion-Ceramic Aircraft Spark Plug Maintenance Manual. An aircraft spark-plug maintenance manual has been issued for the purpose of aiding spark-plug users in obtaining maximum performance and operating efficiency. Sections deal with the design and construction of the plugs, installation, reconditioning, testing, and inspection. *Champion Spark Plug Company*, Toledo, O.

Jacobs Service Bulletins

Two new additions have been made to the Jacobs Aircraft Engine Company's Service Bulletins. One is Bulletin No. 27-A (which supersedes Bulletin No. 27) concerning installation of restriction in oil supply to automatic valve-lubrication system for Jacobs L-4, L-5, and L-6 series engines. The other is Bulletin No. 31, pertinent to ring combinations for L-6 series engines and oil-jet installation for L-5 and L-6 series engines. *Jacobs Aircraft Engine Company*, Pottstown, Pa.

Production and Maintenance Suggestions

The Bellringer, August, 1944. (1) A schedule-control board for airport operations reduces the time required for determining how many airplanes are located in the airport, how many are scheduled, and the amount of work to be done on each plane; (2) a special guard protects the "dead man's trigger" of aircraft guns during shipment; (3) a new jig for scribing extrusions is faster, more accurate, and permits a considerable saving in material.

Douglas Airview, August, 1944. (1) New-type dies for swaging balls on rotary machines permits substitution of swaging for riveting; (2) template for vertical laps on plating panels increases production; (3) four-way operational form block eliminates hand-forming, and enables work formerly performed in 8 hours to be done in 36 min.; (4) form block used on hydropress to remove wrinkles on outside contour sheet-metal parts eliminates hand work; (5) attachment for angle grinder on Wardell saw-grinder enables operator to sharpen curled-chip type saws and makes possible the grinding of a 5° bevel on metal-cutting and angular-tooth saws; (6) combination dimple and pierce die for dimpling holes in parts when blanked out eliminates hand tooling and saves times; (7) protective procedure for covering sharp edges on skin cutouts for wire run along tunnel of fuselage section eliminates rejections and saves both material and man-hours; (8) die to make piercing pins from drill rod stock enables pins to be made cheaper, aids in making odd sizes and odd length pins; (9) crimping and welding end of cap line on engine fire-extinguisher system eliminates parts; (10) clamp for locating longeron attaching angles on channel type frames aids drilling, enables contours to be more readily maintained and results in better job; (11) replacement of free-floating bearing by thrust bearing in Farnham spar-cap mill eliminates chatter; (12) fixture for holding form sheet tightly in position eliminates gaps between skin and frames, eliminates slippage and canning, and reduces riveting and rework time; (13) limit switches to stop Farnham mill when flying clamp fails to open prevents damage to cutters, hyraulic units, spindles, etc.

North American Aviation, Inc., Take-Off, August 11, 1944. Stainless-steel washers attached to the contactors on all spotwelders change the magnetic characteristics of contactor switches, result in less production time lost for adjustment of the machines, and lower the cost of replacing contactor tips.

The Consolidated Vultee Eagle, August 3, 1944. (1) Solder pot for small tool armatures; (2) bearing puller for electric drills; (3) clamp crimper for a hose.

The Faircrafters, August 11, 1944. Equipping center-section nose and tail rib jibs with $^3/_8$-in. bolts and hex-head nuts enables a speed wrench to be used in tightening them and saves a number of tooling hours in the conversion of jigs.

Interstate-ments, August 11, 1944. (1) New style grommet for Camloc fasteners in plywood skins can be in-

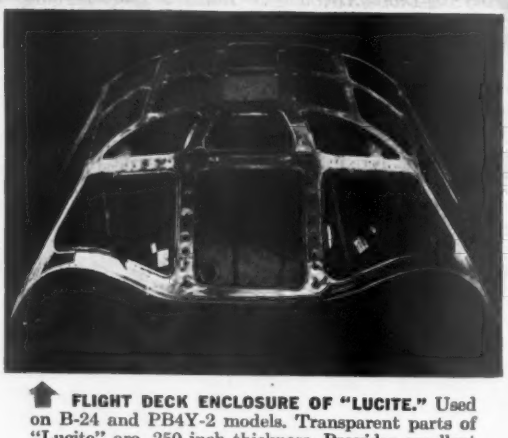
HOW CONSOLIDATED VULTEE USES "LUCITE"

Crew of B-24 Liberator Bombers enjoy clear vision through enclosures of Du Pont methyl methacrylate resin sheeting

HERE IS another plane builder who—like Curtiss-Wright, North American, Martin, Douglas, Boeing and other leading aircraft manufacturers—uses Du Pont "Lucite" to provide excellent vision for pilot and crew.

Of prime importance is the *transparency* of "Lucite." Even in maximum thickness this colorless, crystal clear sheeting absorbs less than 1% of visible light. Its light weight, excellent tensile properties, resistance to chemicals and ease of forming, finishing and mounting make it suitable for a wide variety of aircraft applications.

WRITE FOR "LUCITE" MANUAL. This pocket-size, graphically illustrated guidebook lists physical properties of "Lucite" and shows most efficient methods of care and handling. For a free copy write on your business letterhead to E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, N. J., or 5801 South Broadway, Los Angeles 3, Calif. In Canada: Canadian Industries, Ltd., Box 10, Montreal.



FLIGHT DECK ENCLOSURE OF "LUCITE." Used on B-24 and PB4Y-2 models. Transparent parts of "Lucite" are .250 inch thickness. Provides excellent optical qualities for the sides and top.

SWITCH GUARDS OF "LUCITE." On B-24, PB4Y-2 and PBY-5 models. In addition to its use as transparent enclosures, "Lucite" is used for guards to prevent accidental turn-offs of switches and instruments. Thicknesses of .125 and .250 inch are used.

Accident Prevention Speeds War Production

DU PONT

DU PONT PLASTICS

BETTER THINGS FOR BETTER LIVING ...THROUGH CHEMISTRY

stalled in one operation and does not require drilling of rivet holes, countersinking, or riveting; (2) a compact testing device for checking the rewiring operation and the various electrical circuits eliminates necessity for removing the covers of junction boxes and reduces possibilities of errors in checking; (3) an improvement to the commercial bond meter clamp that is used for bonding electrical boxes and stranded wire results in prolonged usefulness of the equipment and more accurate meter reading; (4) a combined punching and dimpling tool punches and dimples grommet holes in skins in one operation and eliminates single hole sawing, dimpling, and burring operations, reduces amount of handling by 50 per cent, and achieves proper tolerances; (5) countersunk and slotted plates that can be welded to common type pliers to hold Adel clamps and screws in position while the nut is being assembled.

The Kollsman Instrument Dial, August, 1944. (1) A die to punch out the location pins in the altimeter bridge; (2) a change of mold of a pitot tube does away with one filing operation; (3) reaming the holes in studs effects economies in the Altimeter Department; (4) a special needle for winding wire replaces the customary procedure of using tweezers for the winding process.

McDonnell Bulletin, August 25, 1944. (1) A change in the method of putting pilot holes in certain attach angles speeds production; (2) putting clamps on all rudder and elevator jigs and making jigs for certain clamps saves time required for inserting and removing cleco buttons on assemblies; (3) new method of flattening trailing edge flanges for rib attachments causes both sides of the edge to be flattened in one operation.

North American Aviation, Inc., Take-Off, August 25, 1944. A suggestion for simplifying the hand forming of rib flanges by an easier way of attaching back-up plates to form blocks so that ribs are held securely for the forming operation.

North American Skywriter, August 4, 1944. A new method of forming beads and dimples on a hydro press, based upon the use of rubber strips.

North Ameri-Kansan, August 11, 1944. (1) Pneumatic lift for outer jig templates reduces fatigue in handling and eliminates the need for a second operator to assist in the lifting; (2) a reference board for small parts simplifies the method of checking the catalogue numbers and parts sent by outside vendors.

Douglas Tulsa Airview News, August 11, 1944. (1) Autopilot test unit simulates the action of an autopilot stabilizer, serves as an accurate ground check on the autopilot and bombsight, and saves man-hours; (2) a scribe bar for trimming and fitting cowling skins eliminates improper tolerance because of the contour of the skins when the joining is made.

The T.W.A. Skyliner, July, 1944. (1) A jig for holding ignition looms in an accessible position while new wires are being installed; (2) a jig for holding a complete set of ignition wires in the most advantageous position for finishing off with a drop of solder where the wire enters the magneto block; (3) a tool to be used in removing core gaskets from spark plugs; (4) a test "Jeep" is used in connection with the overhaul of fuel-quantity gauge equipment; (5) removal of a $^1/_4$-in. vent line from oil tanks results in a slight weight reduction as well as an economy of material and maintenance hours; (6) a revision to the bank-and-turn filter holder effects a neater installation and a saving in time.

The Consolidated Vultee Stinsonair, July 15, 1944. (1) Improved method of setting nibbling punches in the collet of a machine increases the life of the punch about 30 per cent; (2) an improved system for capping tubing; (3) a new method of removing bearings eliminates a considerable amount of scrapping.

North American Aviation, Inc., Take-Off, August 18, 1944. A washing unit for cleaning drill-motor ball bearings eliminates the disadvantages of cleaning bearings by hand.

Consolidated Vultee Convair News, August 25, 1944. A jig for drilling fabric attachment hooks on aircraft rudders and elevators.

The Curtiss Wright-er, August 11, 1944. (1) A jig for cleanup riveting on leading edge ribs; (2) procedure for installing deicer and line assembly while the aircraft nose is in the preassembly jig; (3) a template for drilling clips on stringer; (4) a counterbore plate for an Atlas mandrel press; (5) a device for holding strip material and skins while blanking or perforating on punch presses; (6) a special use for templates in the stack drilling of cleco holes in heater ducts; (7) a redesigned vise jaw for milling links; (8) a specially constructed jack to aid in positioning the mid-section outer-panel skins in the main outer-panel assembly jigs; (9) rack for holding long parts and skins in salt bath; (10) replacement of soft rivets with paper fasteners for temporarily holding stringers and doublers between bulkheads in place.

The Jahco News, August, 1944. (1) A new type tool-holder for boring and facing housings eliminates one operation and increases production; (2) idea for installing an intake valve on the line running from the degreaser to the still, and a valve to drain fluid from the still to the degreaser; (3) steel plates for armature trucks eliminate "tote" pans and hold 30 armatures to a section or 1,080 armatures to a bake; (4) change in type of burring gears for Gardner grinder relieves burr department of a hand operation, maintains same quality of workmanship, and increases production.

The Flying M, September 1, 1944. (1) A multiple stop for a boring bar; (2) a lathe fixture for applying chrome polish to aircraft.

Convair News, September 1, 1944. (1) Installation of counters on punch presses eliminates hand-counting of parts during and at the end of parts runs; (2) improvement on radial arm router blocks.

Douglas Airview News, September 2, 1944. (1) Idea for attaching a spring lock to toggle pliers and adapting them to assembly operations obviates the use of clamps for holding the assemblies together; (2) an overhead hoist using a Thor pulley has made it possible for a standard drill and rivet machine, operated by one man, to exceed the output of two hand-workers in assembling segments of the antidrag line.

The Consolidated Vultee Volunteer, September 1, 1944. (1) A specially shaped pin router bit eliminates unwanted slugs; (2) a special stop countersink for spotfacing.

North American Skywriter, August 25, 1944. (1) Use of tool holders on Linley machine eliminates need for collets and speeds work; (2) use of a magnetic sine bar speeds tool grinding; (3) automatic window opener for welding mask.

The Consolidated Vultee Eagle, August 24, 1944. (1) Installation of toggle clamps on locating fingers of nose bucks; (2) oil sand core replaces rivet in drop-hammer die mold.

The Consolidated Vultee Volunteer, August 25, 1944. (1) Suggestion for a marker to locate the center of corrugations on skins; (2) a squeegee for washing down the center section of the wing.

The Bellringer, September, 1944. (1) Air-cooled method of silver soldering thermocouple plugs eliminates burning of plugs, enables one person to do work that formerly required two people, and reduces amount of time required for soldering; (2) a gauge for measuring gun-mount segment vanes saves time and material.

AllisoNews, Second July Issue. (1) A bronze casting for an engine bearing, commonly known as a "bear trap," caused trouble because of porosity. It was suggested that the lathe operator mark the porous spots after turning the part to size, so that the mill and drill operators could locate the part in the fixture and machine out the defect. In two months the suggestion saved enough material from bearings previously scrapped to warrant the maximum award of a $1,000 bond. (2) A sample protective filler to guard bearings against, mutilation during transportation resulted in reducing transportation damage to a minimum. (3) Two turret lathes were relocated in such a way that a single operator could handle both machines.

This big black battlecruiser is the
first true night fighter

NORTHROP BLACK WIDOW
P-61 NIGHT FIGHTER

You're looking at the largest fighter plane ever built. It packs not just a pilot but *three* fighting specialists.

It is specially equipped to hunt down enemy planes in the dark. And it's "loaded for bear" with a battery of cannon and machine guns which can destroy anything that flies.

The big Black Widow has pursuit ship speed and climb. Yet it is a sweetheart to handle. It can fly securely on only one of its over-2000 h.p. motors. It is specially designed against stalling in the tightest turns —still more insurance for our fliers. And for extra safety on small, dark fields, the Black Widow is built to take off quickly, land very slowly.

That's a lot of performance for a plane as big as a heavy standard transport. But outstanding aircraft design and production is Northrop's trade. As the Northrop group produces the revolutionary P-61 today, Northrop is pioneering still more advanced airplanes for tomorrow.

NORTHROP *Designers and Builders of the* ***BLACK WIDOW P-61 Night Fighter***

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carry on only one of its over-2000 h.p. motors. It is specially designed
Northrop is pioneering still more advanced airplanes for tomorrow.

From the Industry

Postwar Rehabilitation and Merchandising Plan

A plan for the postwar merchandising of personal-owner type aircraft, with considerable emphasis on providing job for returned men, has been announced by the Aeronca Aircraft Corporation.

The plan will be put into effect by systematically schooling potential airfield operators and aircraft salesmen in how to arouse consumer interest in small airplanes.

As part of the project three handbooks have been prepared for distribution. One is titled "How to Make Small Airports Pay"; another, "Why You Should Be an Aeronca Dealer." A third book, to appeal to retail buyers, is titled "Aeronca, the Plane You'll Want to Fly." A fourth book, "The Airplane Dealer's Handbook," is now in preparation.

The first of the booklets indicates to the prospective airport owner how and where his business should be located. If a man is in doubt, the company will help him scout any given territory and determine the desirability of land intended for an airport. It will assist him in surveying areas to determine "airport populations," the flow of air and land traffic, the character of business in the area to determine the level of purchasing power, and the nature of the adjacent community or communities.

The booklet outlines the economics of airport operation and details the various revenues that may be anticipated. Such factors as can make a field attractive or unattractive to resident and itinerant fliers are described.

The handbook for airplane dealers indicates that, in keeping with automobile-agency practice, the cost of flying lessons should be applied on the purchase price of an airplane if, within a year of his initial flight, the student decides to acquire an airplane. In the belief that a business run on such a basis requires additional bookkeeping, a model bookkeeping system will be supplied the dealer.

The postwar program includes an insurance plan that will effect a substantial saving in insurance premiums to future purchasers of the company's airplanes. It also provides for aids and guidance to dealers in the promotional, public relations, and publicity phases of their business. Aeronca Aircraft Corporation, Middletown, O.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

A.C.-D.C. Electrode for Light-Gauge Metal Welding

Airco No. 90-A electrode, an improved version of the smaller sizes of Airco No. 90 electrode, is especially designed for welding light-gauge chrome-molybdenum and similar steels used in aircraft welding. It is made to a new coating formula that is said to provide smoother arc operation in addition to better appearance of deposits, stronger arc action, reduced slag interference, and excellent operation at high currents without deterioration of coating at stub end.

The electrode is available in all three of the popular sizes for light-gauge welding: $^1/_{16}$-in., $^5/_{64}$-in., and $^3/_{32}$-in. diameters. It is equally efficient for both a.c. and d.c. operation, straight or reversed polarity. Test specimens welded on SAE 4130 with the No. 90-A electrode show transverse tensile strengths of 80,000 to 90,000 lbs. per sq.in. The electrode meets the requirements of U.S. Army Air Corps Specification 10286-B, Type 1, Grade 2E, and conforms to A.W.S. and A.S.T.M. Specifications for Classification E 6013. Air Reduction Company, New York.

Airplane Landing Mats Made of Aluminum

The urgent need for lightweight airplane landing mats that can be airborne or carried by small cargo vessels into places inaccessible to heavy equipment has been met through the development of an aluminum mat. This mat, weighing one-half as much as the older steel mat, is intended to facilitate the construction of advance airfields in China, Burma, and the islands of the Pacific.

Contracts for the manufacture of aluminum mats have been let by the U.S. Corps of Engineers through the Procurement Division to the U.S. Gypsum Company, Chicago, and the United Steel Fabricators, Wooster, O. The contracts call for 12,000,000 sq.ft. of landing mat, in the construction of which more than 45,000,000 lbs. of aluminum will be used.

The aluminum landing mat is built up of a large number of sections, called "planks," each approximately 15 in. by 10 ft. The planks are ribbed and pierced with flanged holes for increased stiffness. The flanged holes also make for a lighter mat. Assembly of the planks into a landing mat is effected by fitting adjacent planks together by means of a slide lock, known as a "bayonet lock."

After exploring the forming possibilities of a number of the strong aluminum alloys, the producer of the sheet aluminum made up sample mats in what it considered the proper gauge sheet, of several of the most promising alloys. These sample mats were tested by laying the assembled planks on soft, clay soil that had been partially smoothed out by means of a bulldozer, and running heavily loaded trucks over them to study their performance under load. The best alloy and gauge material were determined and additional mats were made which the U.S. Engineers Corps tested first under truck load, and later, on a landing field at Eglin Field, Fla. In the last test, airplane landings and take-offs were made on the mats.

The design of the aluminum landing mat is quite similar to the steel mat. The sheet in the aluminum mats is Alcoa 61S-T alloy, 0.188-in. thick, having a yield strength of 35,000 lbs. per sq.in.; while the sheet in the steel mats is SAE 1010, 0.134-in. thick, and having a yield strength of 33,000 lbs. per sq.in. By increasing the thickness of the aluminum sheet approximately 40 per cent over that of the steel sheet, the same stiffness or rigidity was obtained as in steel, yet because of the light weight of aluminum, the aluminum sheet weighed only one-half as much as the steel sheet. The planks in the aluminum mat weigh approximately 35 lbs. each, while the same size planks in the steel mat weigh 70 lbs. each.

The aluminum mat is not designed to replace but to supplement the steel landing-mat program. The portable feature of the aluminum mat is expected to prove valuable in those sections where transportation is extremely difficult or speed is imperative. The planks for the aluminum mat can be flown to advanced bases and readily assembled because of the light weight. Aluminum Corporation of America.

Aircraft Heater Utilizes Vapor Entraining Principle

The model SRH-15 aircraft heater has a rated output of 15,000 B.t.u. per hr. It is cylindrical in shape, and measures $4^5/_8$ in. in diameter by $18^3/_4$ in. long. Its weight is 6 lbs. 14 oz., including controls and accessories.

The new model is based on the combustion process of vapor entraining developed by this manufacturer. It utilizes a capillary vaporizing block in conjunction with preheated air. It is claimed that the flame has such stability that its characteristics are the same regardless of altitude or speed. Barometric compensation provides for uniform combustion conditions from sea level to 40,000 ft. Anchor Post Fence Company, Fluid Heat Division, Baltimore.

Small Carbide-Tipped Tools

To meet the need arising from the increasing use of carbide-tipped tools on small, high-speed high-precision lathes, as well as in boring bars and in tool holders for fine work, a $^1/_4$-in. size tool has been added to the maker's line of Style 4 and Style 7 right-and-left-hand standard turning tools. The new tools, available from stock in Grade 78 for steel cutting and in Grade 883 for all other materials, have a $^1/_4$-in. square shank $1^1/_2$ in. long. They have tips measuring $^3/_{32}$ in. thick, $^3/_{16}$ in. wide by $^5/_{16}$ in. long. The tools are being regularly packaged for shipment from stock in quantities of 12, although they are also available in other quantities. Carboloy Company, Inc., Detroit.

Machining Supercharger Forgings

A method of overcoming tool troubles caused by a combination of scale and work hardening of stainless steel supercharger rotor forgings was evolved recently on a job involving turning and facing operations with cemented carbide-tipped tools.

In the machining of this part it was noted that failures on tools occurred at any point where the tool was cutting a previously machined surface and also at the scale line. The former trouble was found to be attributable to the fact that stainless steel of the analysis being used work hardens rapidly and this increase in hardness penetrates to a depth of several thousandths of an inch. Therefore, a feed above 0.008 in. was maintained, which successfully overcame the trouble previously caused by the carbide-tipped tool cutting through work-hardened stock.

The tool design was worked out to furnish the added strength and chip-breaking qualities needed when cutting through the scale on the stainless-steel forgings. A negative strength land on the tool reduces the tendency of the material to tear out the tool's cutting edge.

In addition, a reverse-angle breaker of from 4° to 5° prevents the chip from curling back and impinging against the cutting edge at approximately the scale line, as it otherwise would do on this particular setup. In this instance, it was found that the best way to put the breaker in is to grind a regular breaker at 15° positive rake at a reverse angle to the cutting edge. After the breaker is in, a land at from −2° to −3° and 0.015 in. wide is ground on a 6-in. diamond pedestal grinder.

With the tool described, an average of 10 pieces was faced and turned between grinds, although the part had a Brinell hardness of 280 to 320. The speed was 140 to 160 surface ft. per min. with a depth of cut of $1^1/_2$ in. Carboloy Company, Inc., Detroit.

Instrument-Panel Markings

To make certain that the markings on the instrument panel before the pilot are clearly visible by day and night, a plastics fabricator has produced identification plates made of lightweight, smooth-surfaced Lumarith in combination with fluorescent ink. When the plates are viewed during the day the white ink stands out sharply and the instructions can be read clearly. At night the borders and trim on the plates become invisible and only the essential wording printed in fluorescent ink can be seen, so that the pilot's attention is not diverted by any extraneous matter.

Each plate consists of two sheets of Lumarith. The lettering is put on the

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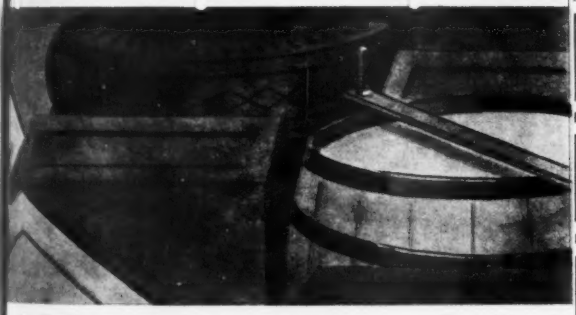

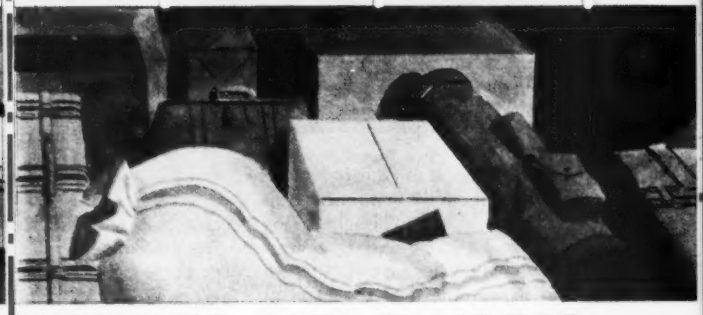

PROVEN IN WAR — FOR PEACETIME PERFORMANCE

In war the Curtiss Commando has established itself as a major instrument of transportation. It has hauled personnel and supplies of all types wherever the need has been critical—often under most unfavorable flying conditions.

Evolved from an airline design, the Commando will be available for commercial operation as soon as the strategy of war permits. Its conversion into a luxury airliner or a cargo carrier will be speedy. This will help to bridge the gap between war and peace by providing jobs for the men and women who build and operate these transport airplanes. Look to the Sky, America!

Curtiss-Wright Corporation, Airplane Division.

Curtiss Commando

Low Bidder For Tomorrow's Air Commerce

BAKELITE

TRADE-MARK

FLOORS THAT FLY—

Low-pressure laminated flooring, made with BAKELITE phenolic laminating varnish, is doing an essential weight-saving job in bombers, gliders, and troop carriers. This new flooring material has an extremely high strength-weight ratio as compared to the sheet metal and plywood formerly used. It is produced, too, with an ease and speed that effect substantial economies.

This lightweight, durable flooring, a product of Consolidated Water Power and Paper Company's Plastic Division, is formed by low-pressure laminating-molding with BAKELITE resin varnish BV-16526. Its wood veneer core is surfaced with high-strength Consoweld, a Mitscherlich sulphite paper. Laminating pressure is about 200 lb. per sq. in. Regular hydraulic presses produce the flooring in 6 ft. by 16 ft. sections. Surface color is incorporated in the paper stock, and the surface is embossed in the single press operation to secure a safe, non-skid finish. Edges are sealed for thorough moisture resistance.

Low-pressure laminating-molding opens many opportunities for reducing the weight of products, without loss of mechanical strength or dimensional stability. Even the molding of structures with compound curves is an everyday procedure. Write Department 25 for further information on the advantages of this new technique. It may be of outstanding value in essential production now, or help guide your planning for tomorrow.

TRADE MARK

BAKELITE CORPORATION

Unit of Union Carbide and Carbon Corporation

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UCC

PLASTICS

THE MESH AND WEAVE YOU NEED . . .

in durable corrosion-resistant strainers

Photo courtesy of C. O. Jelliff Mfg. Corp.

TYPICAL STRAINERS PRODUCED IN MONEL

1—Finger type aircraft engine oil strainer, formed from 16 mesh Monel wire cloth with brazed seams.

2—Gasoline tank screen made from 10 mesh, 0.025" diam. Monel wire.

3—Strainer for hydraulic landing gear system. Made from 100 mesh Monel wire cloth with copper alloy end ring and solid bottom.

4 and 5—Refrigerator strainers, made from 80 mesh and 200 mesh Monel wire cloth.

6 and 7—Strainers for marine valves, made from 20 x 100 mesh plain dutch weave Monel wire cloth.

No matter what size or shape of strainer you want, chances are you'll find it made from a wire cloth of Monel, Nickel or Inconel.

These materials possess the following advantages:

1. High strength, rigidity and toughness.
2. Wide corrosion resistance. Ability to withstand marine atmospheres, salt water, ethylene glycol, anhydrous ammonia, compressed oxygen, fire fighting solutions, tetraethyl lead and other high octane gasolines and their combustion products.
3. Resistance to high temperatures, and freedom from low-temperature brittleness.
4. Ease of forming and joining.
5. Choice of welded, soldered or brazed seams.
6. A large selection of standard weaves and meshes.
7. Low cost . . . Monel wire cloth is *lowest in cost* among metal fabrics of comparable high strength and corrosion resistance.

The C. O. Jelliff Mfg. Corporation of Southport, Conn., whose strainers are illustrated, is one of the prominent weavers with long experience in nickel alloy wire cloth and strainer production. The output of Monel, Nickel and Inconel wire cloth goes today entirely for war requirements and for essential production and maintenance where the unique properties of these materials are needed.

For technical data on the INCO Nickel Alloys write today for a copy of the handy booklet, "Inco Nickel Alloys for the Aircraft Industry." Address: The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

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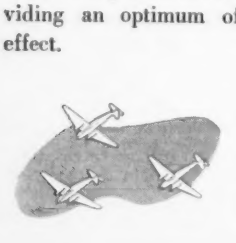
FIBERGLAS* XM-PF
Aircraft Insulation

Only by *seeing, feeling, weighing* and *flexing* this new insulation can you realize how radically different it is from other insulations; also why every ounce available has been going into U. S. Military Aircraft.

Fiberglas XM-PF Insulation is made up of inert, inorganic material —glass in the form of very fine fibers bonded into a flexible mat form. It is easy to handle and fabricate. It requires no stitching or felting to maintain its form and shape, even under extreme vibration. And it weighs as little as *one pound* per cubic foot, while providing an optimum of insulating effect.

This new material has a merit factor of over 80 as *acoustical* insulation when properly installed. This, combined with its light weight and durability has made it ideal for the acoustical treatment of pilots', radio operators' and navigators' compartments in aircraft.

Its *thermal* uses in aviation include the insulation of hot-air ducts and fittings on aircraft, also the insulation of cargo and troop transport compartments. Being made of glass, the fibers will not rot or burn. Equally important, this insulation absorbs a negligible percentage of moisture under extremely humid conditions.

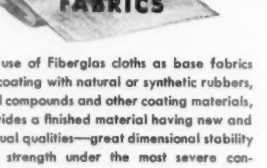


If you are not already familiar with Fiberglas XM-PF Aircraft Insulation, it will pay you to investigate its many advantages. Why not get in touch with the branch office nearest you? Or you can write to *Owens-Corning Fiberglas Corporation, 1893 Nicholas Building, Toledo 1, Ohio. In Canada: Fiberglas Canada Ltd., Oshawa, Ontario.*

OTHER AIRCRAFT USES OF FIBERGLAS

Another type of Fiberglas thermal insulation, these fireproof blankets (known as Design No. 3) are made of Fiberglas insulating wool, Type N, faced with Fiberglas cloth and stitched with glass thread. Available in 1½ lb. and 3 lb. densities, they are extensively used to insulate gasoline heater exhausts, heat exchanger ducts, other high-temperature pipes, etc.

The use of Fiberglas cloths as base fabrics for coating with natural or synthetic rubbers, vinyl compounds and other coating materials, provides a finished material having new and unusual qualities—great dimensional stability and strength under the most severe conditions of humidity, temperature and hard usage in combat. Widely used in the fabrication of gun bore sight screens, insulation covering, flexible connections, bunks, fuel cells, distillate tanks, many other items.



Made by combining certain low-pressure resins with Fiberglas—glass in the form of fine fibers—these materials provide great strength with light weight; exceptional ability to absorb shock; dimensional stability under moisture changes. These and other properties of this amazing new structural material are described in a booklet of reprints of articles which appeared recently in "Modern Plastics". Write for your copy.

Another all-glass product—woven from Fiberglas yarns. While extensively used for insulating motors, generators and other electrical equipment, many other applications have been found for these durable, incombustible tapes in aviation—such as covering of thermal insulations on hot air ducts, ties for removable insulating pads, etc.

FIBERGLAS ..A BASIC MATERIAL

*T. M. Reg. U. S. Pat. Off.

first sheet in luminous ink and the border and trim are applied with regular ink. Then the second sheet of Lumarith plastic, finished with a matt surface to eliminate glare, is laminated over the printed surface to give permanent protection. Celanese Celluloid Corporation, New York.

New Surface Grinder

The new model G-1 DoAll Surface grinder is stated to embody scientific developments in balance and construction resulting in new achievements for precision grinding and fine finish. With standard grit wheels, the machine produces a fine finish to within 6 micro in. An innovation in design gives the operator greater convenience and closer inspection of the work while grinding.

Built for toolroom use and light production work where accuracy is paramount, it has a table travel of 21 in. and transverse travel of $7^1/_2$ in., with a vertical wheel head adjustment of 12 in., using a 7-in. by $^1/_2$-in. by $1^1/_4$-in. wheel. Rigidity is obtained by the scientific balancing of the 2,200-lb. weight of the machine. This is almost double the weight usually found in a toolroom surface grinder.

The column, which extends from the bottom of the base of the machine up to the spindle, is recessed into the base to give greater rigidity to the spindle. This permits a much greater way area, which is handscraped to a precision fit. The saddle has large, extra heavy double "V" ways to prevent any "angle feeding" and to give longer life. Total handscraped way area is 386 sq.in. The working area is completely supported, eliminating any "overhanging," to assure parallelism and flatness over the entire working area. The 21-in. transverse travel and $7^1/_2$-in. cross-feed travel allow plenty of working area for parts being ground on a 6-in. by 18-in. chuck.

A combined hydraulic control unit eliminates all piping. This one unit controls the five hydraulically actuated movements of the machine and was designed especially for this grinder so that no adjustments are necessary. When the surface grinder is under automatic operation, the cross-feed screw disengages automatically. This adds to the life of the feed screw for use in manual operation.

Standard equipment on this new surface grinder is the direct motor-driven, precision ball-bearing spindle. The grinder spindle head is built especially for this spindle and is lapped for a precision fit. The wheel head is raised or lowered by means of a graduated hand wheel operating the vertical adjustment screw through a single gear contact for positive movement. Gears are hardened and ground, with the vertical adjustment screw operating through a 4-in. bronze nut to minimize wear. An exclusive feature is the adjustable wheel guard which enables the operator to lower the guard to compensate for wheel wear or adjust for individual application. The guard is also removable without taking off the wheel.

Convenience in operation is found in the special base design which is recessed to provide knee room for the operator. Since the saddle extends only $8^1/_2$ in. from the table, it allows the operator to see his work without straining. Electrical controls are recessed into the front of the base for the most convenient operation. The cross-feed screw is located in the center of the saddle to assure the smoothest possible cross-feed section. These features permit the operator to sit down at his work and observe closely the grinding of each job to a precision finish with complete dimensional control. The grinder can be changed from full hydraulic operation to full manual operation in an instant.

The inbuilt hydraulic oil reservoir and pump unit is rubber mounted, which isolates all pump and motor vibration against transmission to the work piece. Complete automatic pressure lubrication is provided to all the ways and moving parts. Continental Machines, Inc., Minneapolis.

Tool Post Turret

The Crozier tool post turret for bench lathes is now specially adapted for cutting-off operations. The device operates as follows: One side of the block is channeled to receive a standard beveled section cutoff blade, supported at the top by a hardened channeled bar, which provides maximum bearing surface for the locking bolts. This enables the blade to be quickly and positively centered and to be held in correct vertical position. With no overhang of the holder, the tool extends only to the required depth of cut. This arrangement is credited with assuring rigidity, as well as reducing setup time and increasing production. Crozier Machine Tool Company, Hawthorne, Calif.

Study of Postwar Air Transportation

A decline in postwar air-transportation rates, gradual at first and then accelerating, was forecast by the Director of Business Research of the Curtiss-Wright Corporation, Airplane Division. Numerous improvements in service, a great increase in air travel, and better equipment also are anticipated in a study titled "Air Transportation in the Immediate Post-War Future."

It has been estimated that within 5 years after the war, domestic passenger rates will have declined from the prewar average of 5.1 cents per mile to 3.5 cents a mile, and express rates from the prewar 80 cents per ton-mile to 30 cents per ton-mile. Domestic air travel 5 years after the war is estimated at approximately seven times that of 1940, that is, 700,000,000 passenger-miles as against 104,000,000. Express is expected to show an even greater rate of increase, from 3,500,000 ton-miles in 1940 to 110,000,000, 5 years after the war, while mail is estimated at 87,000,000 ton-miles as compared with 10,000,000 in 1940. Comparable rates of increase are expected in international air traffic. As rates continue to decline and to approach competitive carriers' rates, the effects of the many indirect economies afforded by air transport will begin to be felt in increasing force and air cargo should increase at a rapidly accelerated rate. It is noted that rapid transit makes possible savings in inventories, in interest charges, in insurance, in packaging, and in handling. These savings may not appear important when there is a differential of 15 or 20 cents per ton-mile between air and surface rates, but they may well be critical when that differential has been reduced to a few cents.

It is estimated that approximately 1,500 planes will be sufficient, 5 years after the war, to meet the requirements of U.S. air carriers operating domestically and internationally, as well as the requirements of foreign operators in certain foreign areas that may be accessible to U.S. manufacturers. In 1930 there were 497 planes in use in domestic air commerce. In 1940 the air lines carried 13 times as much traffic as in 1930, but with only 330 planes. In 1943 the air lines handled 50 per cent more traffic than in 1940 with about half as many planes. The apparent contradiction is explained by the increased size of planes and more efficient performance caused by greater speeds, greater load factors, and higher utilization. The trend toward greater size and better performance will undoubtedly continue. Consequently, the increase in the number of planes is not expected to be as great as the estimated increase in traffic.

There is nothing to indicate, the study states, that large planes carrying 150 to 200 passengers will be a common sight on the airways in the immediate postwar years. It may be at least several years after the war before even a single plane of that size will be available to the air lines. Moreover, it probably would not be possible to give the desired frequency of service and still maintain economical load factors with planes of that size for at least a number of years to come. It is estimated that medium trunk-line planes of 30 to 40-passenger size would best suit the requirements of the bulk of traffic during the immediate postwar years. Curtiss-Wright Corporation.

Reverse Thrust Propellers as "Air Brakes"

The U.S. Navy's newest and largest blimp, the Goodyear M-1, can use its propellers as "brakes," through the first adaptation of fully controllable, reversible Curtiss electric aircraft propellers to lighter-than-air craft. In addition, the new blimp can be brought to a virtual standstill in the air by reversing the blade angles of one of its propellers to create "reverse" or backward thrust.

Reverse thrust, which has been used for a long time to give Navy flying boats increased maneuverability on water, greatly facilitates the operation and landing of the new blimp. Engineers also report that the controllable feature permits adjustment of blade

This advertisement is one of a series which is appearing in national magazines and newspapers as Consolidated Vultee's contribution toward a clearer public understanding of transportation's role in the war, and its postwar opportunities and responsibilities.

Sulfa, Plasma—and Air

1. Since the start of the war, thousands of wounded Americans have been evacuated from battle zones by air Said the Air Surgeon General's report "The record places air evacuation in a group with the sulfa drugs and blood plasma as one of the three greatest lifesavers of modern military medicine"

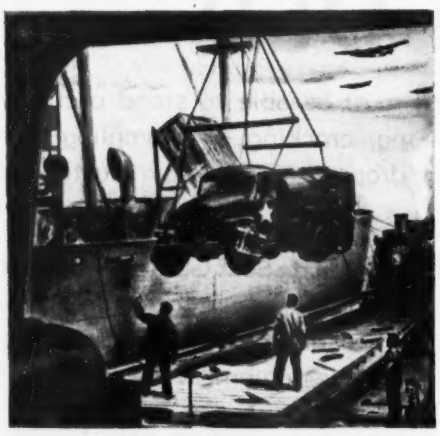
2. In long-range transport planes such as the Liberator Express, no wounded American fighter is more than 60 hours' flying time from the finest hospital in the U S. A.

3. As the hospital plane streaks across the ocean, a flight nurse gives somebody's blood – perhaps *yours* – to this wounded soldier who might otherwise never get home for the special care that will restore him to health

4. From many a remote combat zone, the plane is the *only* means of getting casualties back to base hospitals.

CONSOLIDATED VULTEE AIRCRAFT

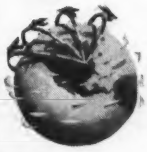
5. The ambulance, hospital train, and hospital ship still transport most of our war casualties. But many a time when *minutes* can save a life, the 4-mile-a-minute speed of the flying ambulance does exactly that!



6. One reason we are winning the war is the way in which the truck, the train, the ship, and the plane are teaming up together. And the task of rebuilding the peacetime world will be a challenge which all forms of transportation must meet in the same way

• • •

But the plane, in addition to its use as a global air transport, will have still *another* role to fulfill: a permanent postwar Air Force can well become the ever-watchful guardian of the peace we shall have won so dearly.



No spot on earth is more than 60 hours' flying time from your local airport

From "Flying Jeeps" to Leviathans of the air — *The planes shown below were all designed and developed by Consolidated Vultee. When peace comes, the company will be in a position to provide the postwar equivalent of such planes, from small, privately owned "air flivvers" to huge, transoceanic cargo-and-passenger planes*

LIBERATOR... 4-engine bomber

LIBERATOR EXPRESS... transport

CORONADO... patrol bomber

CATALINA... patrol bomber

VENGEANCE... dive bomber

VALIANT... basic trainer

RELIANT... navigational trainer

SENTINEL... "Flying Jeep"

QUICK FACTS FOR AIR-MINDED READERS

Air Giant — The new Consolidated Vultee Model 39 transport plane—the Liberator Liner — has passed its test flights successfully. Capacity of this 4-engine transoceanic airliner: 48 passengers—or, as a sleeper, 24. Top speed: 275 m.p.h. Flying range: over 4000 miles.

Airport for Air Giants — New York City's projected airport will have runways totalling 13 miles in length, one of which will be over 2 miles long. This airport can handle 1000 plane movements per day. (Capacity of present N. Y. airport: 270 plane movements per day.)

• • •

1000-mile Shuttle Trips — The Naval Air Transport Service in the Pacific now flies 320,000 miles per week, carries over 5500 passengers monthly, reports that it "adds another stop every time the Japs lose another island."

Tomorrow's Airmen: The total strength of the Army Air Forces now exceeds 2,300,000 officers and enlisted men—a vast reservoir of skilled pilots and aircraft technicians which will insure postwar America's remaining "a nation on wings."

Consolidated Vultee is the largest builder of airplanes in the world.

CORPORATION

San Diego, Calif. · Vultee Field, Calif. · Fairfield, Calif. · Tucson, Ariz. · Fort Worth, Texas · New Orleans, La. · Nashville, Tenn. · Louisville, Ky. · Wayne, Mich. · Dearborn, Mich. · Allentown, Pa. · Elizabeth City, N. C. · Miami, Fla.

Member, Aircraft War Production Council

. . BY COLD

An aviation sealing compound must be able to stand arctic or stratosphere cold without shrinking, cracking or crumbling. No matter how low the temperature drops, it must remain plastic and resilient always.

Since its inception twenty years ago, **TiteSeal** Gasket and Joint Sealing Compound has been in constant service in the coldest ends of the earth and has proven its cold resisting qualities in thousands of planes. Today it rides in practically every plane in the service.

TiteSeal is also heat-proof, pressure-tite, vibration-proof, non-hardening; and is impervious to all of the gases and liquids encountered in airplane motors and equipment.

TiteSeal is made in FIVE DENSITIES to meet every gasket and joint sealing need . . . from the most delicate to the most rugged For information about the many uses of **TiteSeal**, write

TiteSeal conquers cold.

RADIATOR SPECIALTY COMPANY

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RADIATOR SPECIALTY COMPANY OF CANADA, LTD., TORONTO 2

angles in flight, and contributes to faster take-off when the blimp is heavily loaded. The flight engineer needs only to set the blades at take-off angle; then by speeding the engine, the blimp, traveling on its landing wheel and using its underside as a wing, can make a running take-off.

Built by the Goodyear Aircraft Corporation, and powered by two 500-hp. engines, the new blimp is the first of several of its type to be built for anti-submarine patrol duty. Curtiss-Wright Corporation, Propeller Division.

Four-Blade, 18-Ft. Propellers Tested

Curtiss electric propellers, 18 ft. 2 in. in diameter, stated to be the largest propellers ever to fly in this country, have been in service tests on a large Army bomber. Each propeller is designed to transmit upwards of 3,000 hp. in the substratosphere. Despite their size, these four-blade hollow-steel units effect a 20 per cent saving in weight over a propeller of comparable diameter with four solid aluminum-alloy blades and increase the useful load of the airplane approximately 650 lbs. through this weight reduction.

Two other Curtiss-Wright propeller features, reverse thrust and automatic synchronization, are embodied in this installation. With the latter, the four propellers and engines are held in perfect synchronization by a single control. The propellers are also capable of rapid feathering under all climatic and altitude conditions.

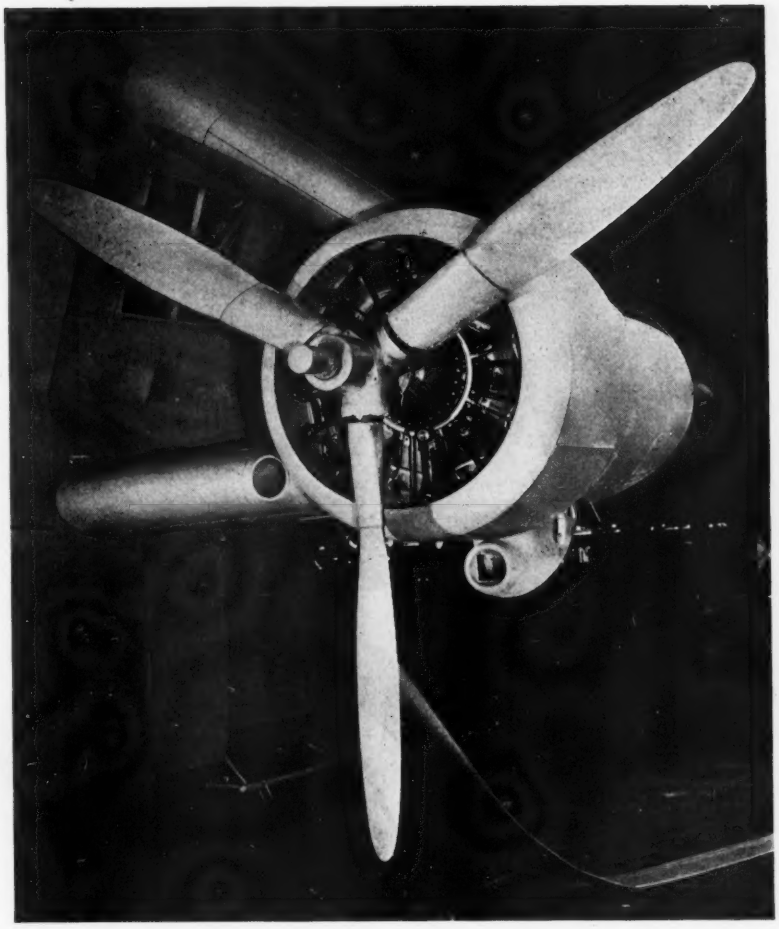
The hollow-steel blades, each 8 ft. 8.5 in. in length and 15 in. wide at the widest point, are of special design and construction. It is stated that through the use of a stiffener rib running longitudinally the length of the inside blade surfaces, the engineers have successfully overcome the problem of high vibratory stresses normally encountered in blades of large proportions.

The design for this basic 18-ft. propeller has been under development in cooperation with the Air Technical Service Command for approximately 3 years. A three-blade version of this design, 16 ft. 6 in. in diameter, was flown for the first time in July, 1942, and is now in service on the Navy's cargo transport, the Martin Mars. Curtiss-Wright Corporation, Propeller Division.

Large Postwar Transport-Aircraft Contracts

Orders for 93 new high-speed, four-engined air liners have been placed with the Douglas Aircraft Company by three of the large air lines. Signing of the contracts marked the first large-scale concerted move to provide domestic and international airways with equipment in the postwar period.

The contracts call for delivery of 25 Douglas DC-4's and 30 DC-6's to American Airlines; three DC-6's to Pan American-Grace Airways; and 15 DC-4's and 20 DC-6's to United Air Lines. The total cost of the planes will exceed $50,000,000.



A three-bladed Curtiss fully controlled electric propeller installed on the Goodyear M-1 Navy blimp.

Under discussion, but not ready for signature, are additional contracts with Eastern Air Lines and other large operators in the United States and abroad. United Air Lines announced that within a short time it would sign contracts for 15 additional DC-6's, making a total of 50 four-engined planes in all for that company. This will place the total number of planes to be produced by Douglas in excess of 100. American Airlines announced that it also expects to order additional four-engined Douglas planes shortly.

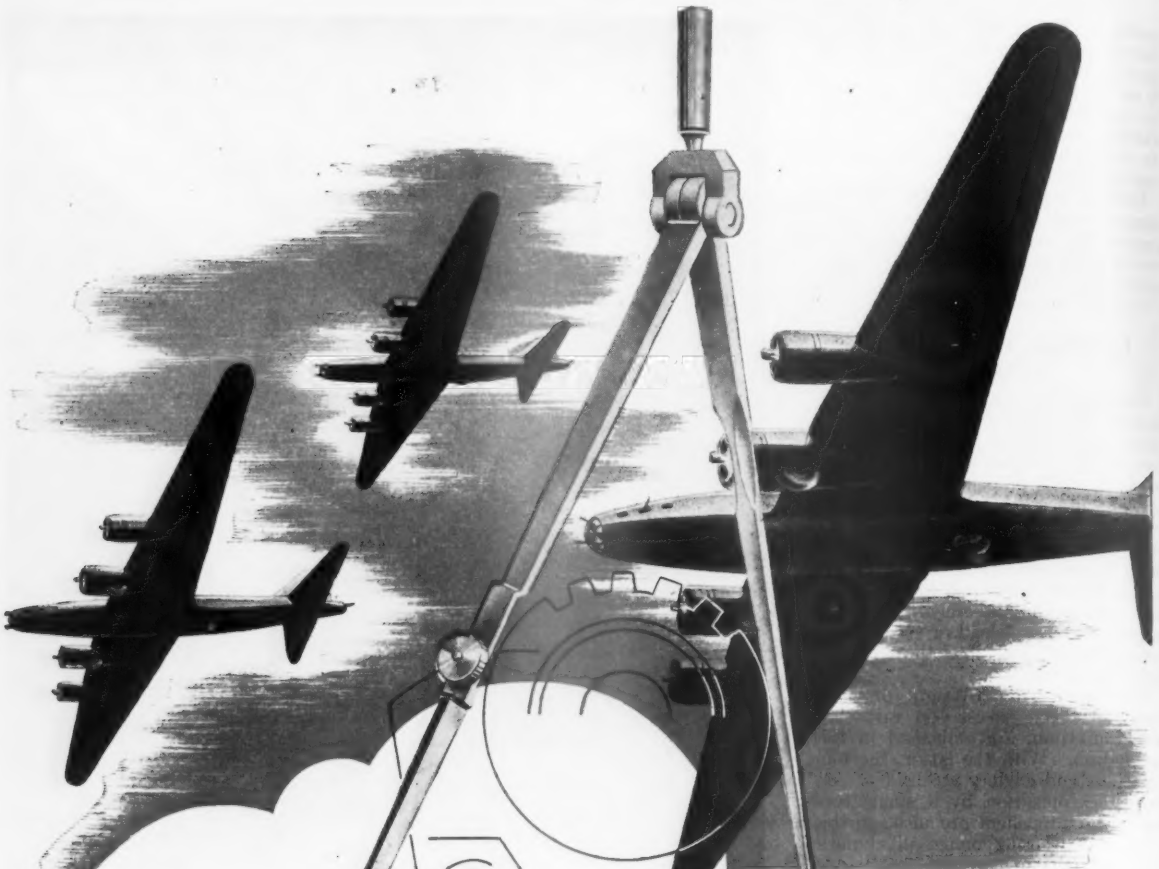
The Douglas DC-6 is described as a 56-passenger and cargo air liner equipped with 2,100 hp. Pratt & Whitney Double-Wasp engines, capable of a speed of 300 m.p.h. This model and the DC-4's will be commercial developments of the military C-54, which has made more than 6,000 ocean crossings. The air lines have flown millions of miles with the C-54 in transocean and intercontinental operations for the Air Transport Command.

The DC-6 is expected to reduce coast-to-coast scheduled time for passengers, mail, and express to approximately $8\frac{1}{2}$ hours, and the Chicago to New York time to 2 hours, 40 min. Similar reductions in flight times between cities will be accomplished on other sections of the nation's airways. The nonstop cruising range of the airplane is 2,715 miles and it can be equipped for increasing this range to 3,540 miles. It will have a gross take-off weight of 80,500 lbs., a wing span of 117 ft., and an overall length of 100 ft. Both the DC-4 and DC-6 will have fully retractable tricycle landing gear, a steerable-type nose wheel, and three-bladed hydromatic Hamilton standard propellers.

The new air liners will offer the most modern refinements in passenger appointments, in scientifically advanced soundproofing, in meal service facilities, and other luxury-travel features. The DC-6 will also have a pressurized cabin. Douglas Aircraft Company.

A.C. Power-Supply Systems

Eclipse a.c. power supply systems, consisting of variable frequency alternators, carbon-pile voltage regulators, and compounding units, are designed to provide a source of either constant or variable frequency for a.c. power or for rectified d.c power. At the present time two models are available, rated at 25 kva., 18.75 kw., and 66.6 kva., 50 kw. They weigh 49 lbs. and 129 lbs., respectively.



Geared also FOR THE JOB TO COME

Honeywell engineering has proved itself through war-time aviation developments that border on the miraculous . . . But the multitude of new problems that peace brings cannot be met only by past accomplishments. At the vast Honeywell test hangar and aeronautical laboratory, practical minded men are prepared for the job to come — prepared through invaluable experience gained in developing the Electronic Autopilot, the Electronic Turbo Supercharger-Control System and other important achievements. This same creative engineering will produce equally valuable contributions to aviation's peace-time needs . . . Minneapolis-Honeywell Regulator Company, 2700 Fourth Ave. S., Minneapolis 8, Minnesota.

MINNEAPOLIS
Honeywell
CONTROL SYSTEMS

Makers of the famous M-H Electronic Autopilot, used on AAF 4-engined bombers

Leadership for the United States in the postwar aviation future was assured when representatives of the nation's major air lines sat down with Donald W. Douglas, the world's largest airplane builder, in New York and signed formal contracts for $50,000,000 worth of new four-engined superliners, which are expected to cut coast-to-coast time to 8½ hours and Chicago-New York time to 2 hours, 40 min.

Seated, left to right, are W. A. Patterson, President of United Air Lines, and Mr. Douglas. Standing, left to right, are Capt. Eddie Rickenbacker, whose order for Eastern Air Lines was not included in the above total but who expects to sign soon; A. N. Kemp, President of American Airlines; and Harold J. Roig of Pan American-Grace (Panagra).

By installing the alternators on constant-speed drives, driven by the aircraft main engines, a source of constant frequency is available. Rectified d.c. power can be obtained from either constant or variable-speed operation over the rated operating speed range of the alternators. Consequently, increased d.c. power is thus available over conventional d.c. power supply systems.

The alternators incorporate an integral exciter, and brushes are designed for efficient, long service at high altitude. A floating-type flexible torque drive shaft compensates for any slight misalignment. Sealed, prelubricated bearings provide complete lubrication under continuous operating conditions. An integral fan, in addition to a tubular armature shaft, contributes minimum operating temperatures.

The 25 kva. alternator delivers its rated output between 7,200 and 8,800 r.p.m., while the 66.6 kva. alternator operates between 5,400 and 6,600 r.p.m. The Eclipse carbon-pile voltage regulators provide continuous regulation without fluctuation and reduce radio interference to a minimum. Eclipse-Pioneer Division, Bendix Aviation Corporation.

Free Flowing Solder for Aluminum

Sheet aluminum can now be lock-seamed, or lapped and spot-welded, or riveted, and the joint sealed with a new free-flowing solder, EutecRod 199, according to the manufacturers of the welding rod. This improved rod supplants the alloy previously known as EutecRod 19B. Used with the maker's Autochemic Eutector Flux 199, the material will flow on aluminum as readily as ordinary lead-tin solder on tinplate, brass, or copper.

The new rod is used on aluminum in the same way the old lead-tin solders would be used on those metals. In long laps it will make joints of moderate strength, but it should generally be used as a seal. It will work on cast aluminum as well as on wrought aluminum, and on steel, copper, and nickel alloys. It is suitable for applications where the completed joint will not be heated over the boiling point of water under working conditions. Its temperature of application, 400°F., makes it possible to join thin sheet metal without danger of distortion.

The material is available in ⅛-in. rod in standard packages of 200, 100, 50, or 25 lbs. Jars of Autochemic Eutector Flux 199, the chemical compound especially developed for use with this alloy, may be purchased in quantities proportionate to the amount of rod required. Eutectic Welding Alloys Company, New York.

Multiple-Camera Control Equipment

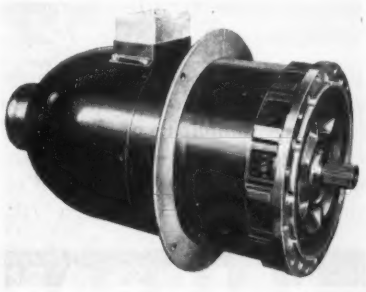
Not only are aerial photographs taken from U.S. warplanes at speeds up to one per sec. in a fully automatic operation, but as many as seven large aerial cameras are operated in synchronization by one controlling device. The demand for new photographic speeds came with the increase in speeds of Army and Navy planes.

Prior to the war, the manufacturer of the cameras and control instruments built the intervalometer, the device for automatically operating aerial cameras at predetermined intervals with a range from 6 to 75 sec. That is, photographs could not be taken at intervals of less than 6 sec. nor more than 75 sec. when a camera was connected to the intervalometer.

With the need for more speed, the Army asked for an intervalometer with a range of 1 sec. to 120 sec. Engineers designed an entirely new unit, which, while smaller in size and lighter in weight, did about twice as much work as the old model. Not only was the 1-to-120-sec. interval range provided but additions to make the instrument more versatile included: an extra-picture switch button, allowing the aerial photographer to take an extra picture if he happened upon an unusual object that did not fall within the interval timing, without interrupting the predetermined scale; a recycle button that also gives the photographer a chance to take an extra picture but this time starting an entirely new cycle; a counter for the number of exposures; a warning light to show each time the shutter is tripped; and a thermostat-controlled electric heater, to provide uniform temperatures for the instrument during high-altitude flight.

This intervalometer can be installed on the control panel of the plane or any other place handy to the pilot, enabling him to operate remotely cameras that may be installed in the tail of the airplane. As the war progressed, the Army began using as many as seven aerial cameras in one plane on joint mapping-reconnaissance missions, and a new controlling device was needed.

It is extremely difficult to operate multiple-camera installations simultaneously, as they include units of widely different focal lengths. The overlap in the photographs did not provide the same area coverage in any given strip of pictures, so what was needed was a multiple timing device to provide uniform percentage of overlap in all photographs taken from an identical altitude but to different scales. The



The Eclipse variable-frequency alternator. The unit shown has a capacity of 66.6 kva. and delivers full load between 5,400 and 6,600 r.p.m.

solution was a camera-control unit in which all electric wiring was consolidated in a group of control, impulse, and switch units small enough to be put in out-of-the-way sections of a plane, with one control box in the installation providing for preset interval timing of photographs for all cameras. Fairchild Camera and Instrument Corporation, New York.

Stripping Fine-Size Formex-Coated Wire Leads

A new method of clean-stripping Formex coating from fine-size wire involves the use of only two chemicals. Heat is used as an accelerating factor, with all operations carried out at temperatures under 500°F. So far as is known, it is not harmful in any way to the operator. Wire coated with Formex or Formvar is used in the manufacture of motor and generator armatures and field coils, as well as solenoids.

For the finer wire sizes, from No. 36 up, the Fairchild corporation found that methods of stripping in common use resulted in physical weakening of the wire itself, sometimes resulting in the failure of armatures and other parts in which it was used. This was especially true when the units had to operate over a wide temperature range of +50° to −50°C., and at high rotational speeds. These finer copper wire sizes tend to become brittle at the high heats required in some stripping methods, or to break or become physically weakened from the abrasive action required in some other methods.

These methods (while successful on larger diameter wires than No. 35) consisted of having the Formex insulation removed by handscraping, using a knife or abrasive cloth, by a rotating wire brush, or by burning over a gas flame or dipping in very high-temperature solder.

The hot solder stripping-tinning method has been one of the simplest and quickest in use up to the time the Fairchild method was developed. An extensive investigation of the destructive action of tin-lead solder proportions and temperatures on various sizes of copper wire has been carried out in conjunction with the Fairchild development. It shows the importance of this destructive effect in the hot-solder method on wire diameter. For example, No. 40 heavy Formex wire required about 3 sec. to be stripped and tinned in soft (40 tin-60 lead) solder at around 1050°F., but within approximately 2 sec. the wire submerged in the solution had been completely dissolved by the necking-down action; No. 34 wire was completely dissolved in approximately 11 sec. Wires finer than No. 40 could not by themselves be dipped into solder for stripping and tinning. Their mechanical strength was not sufficient to overcome the surface tension of the solder.

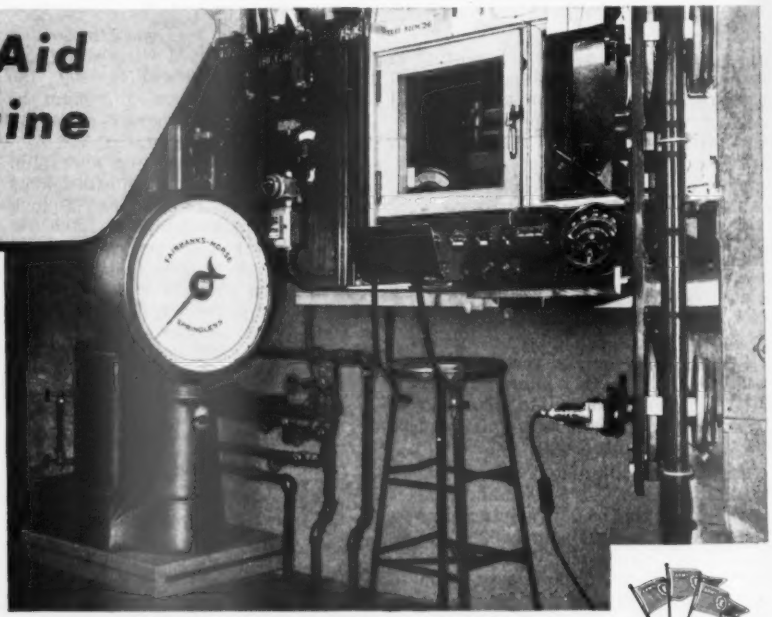
A final review of the results obtained indicated clearly that a two-step method of Formex stripping was preferable. Two materials are involved—material A and material B—each performing one of the steps. Material A serves as the starter. Material B is the accelerator and can be one of several substances comprising a solvent for material A and rendering mechanical removal of the Formex easy and harmless to the fine wire.

The wire to be stripped of Formex coating is dipped to the desired depth in hot, liquid material A for the time required to complete the starting action. This time varies with the wire size, and is approximately 5 to 7 sec. for No. 40 to No. 44 H.F. (Heavy Formex) wires, and 8 to 10 sec. for No. 29 H.F. wire, at the required operating conditions. The time also varies with the temperature and freshness of the bath.

The wire is dipped immediately into warm material B for approximately the same time as required for the material A dip, and to a slightly greater depth than in the material A.

Immediately upon removal from the material B, the wire is stroked gently one or more times as required, between the thumb and forefinger to remove the softened Formex. Should the softened Formex become dry or harden when partially stripped from the wire, because of slow handling, etc., the wire should be redipped in material B to rewet it. However, the softened Formex generally slides from the wire as a

Scales Aid Plane Engine Testing



UNCLE SAM takes no chances with aircraft engines. Before they're mounted, they must be tested for power developed, heat, and gas and oil consumption. Doing the latter job at Continental Motors is a battery of Fairbanks-Morse Fuel Test Automatic Dial Scales.

Fairbanks-Morse Scales can do an accurate job for you, too. Their dependability and simplicity of design are backed by *114 years of scale-building experience.* Fairbanks, Morse & Co., Fairbanks-Morse Bldg., Chicago 5, Ill.

Test engineer's observation post outside an individual engine test cell, showing the Fairbanks-Morse Scale and the gauges which indicate engine performance.

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From blueprint to bomber, fighter, or transport plane, Bendix landing gear is under the constant supervision of men with the broadest experience in this highly specialized field.

One outstanding advantage provided by this experienced personnel is the forethought shown at every stage. Strains, shocks and performance requirements are accurately foreseen—and the ability of the landing gear to meet them is predetermined in a series of practical tests in the best-equipped laboratories available anywhere.

***Trustworthy*—that sums up the dominant characteristics of this fine product of Bendix Creative Engineering. For proof, simply check the list of manufacturers who rely on Bendix landing gear for safer, easier take-offs and landings.**

Checking strut in Drop Test Rig

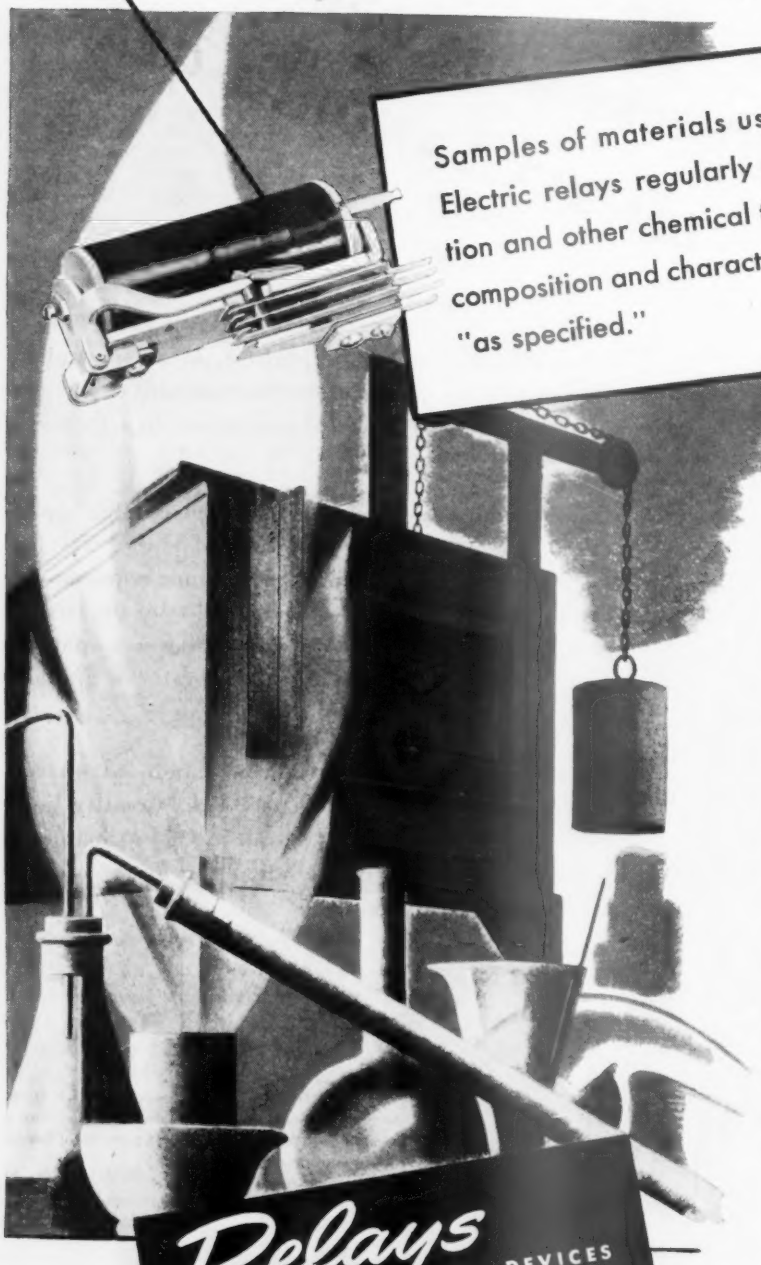
Testing brake power on 30-ton dynamometer

BENDIX LANDING GEAR—Bendix Pneudraulic Shock Struts, Bendix Airplane Wheels, Airplane Brakes, Hydraulic Master Cylinders, and Power Brake Valves make up the list of Bendix Landing Gear equipment.

Bendix PRODUCTS DIVISION

BENDIX AVIATION CORPORATION, SOUTH BEND 20, INDIANA

"The Heats On" To Verify Relay Material Composition



Samples of materials used in Autcmatic Electric relays regularly undergo combustion and other chemical tests to insure that composition and characteristics are exactly "as specified."

It may seem a simple matter—this job of selecting the right materials for making relays; but—

Automatic Electric designers know better. They know that correct design is only the beginning—that materials must also meet exacting standards, or performance will suffer. That is why they insist that quality control must begin in the laboratory.

When you need relays, call in the Automatic Electric field engineer. He can show you how quality pays, in longer life, better performance. In the meantime, for a preview of the Automatic Electric line, write for Catalog 4071.

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soft tube in one or two strokes without redipping.

The new method has been used on 10,000 small motor armatures, where the lead terminations average 14 leads per armature. Since each lead-stripping operation can be completed in less than 30 sec., it is estimated that a 50 per cent saving in normal man-hours has been achieved. In addition, no wire failure has been noted since the system was adopted. Fairchild Camera and Instrument Corporation.

High-Speed Milling Process

Details have been revealed of a unique milling operation done with special high-speed fly cutters in wartime quantity production of precision aircraft cameras and other Fairchild instruments needed by the armed forces. For those manufacturers who have production problems similar to those in the manufacturer's plants, this method of milling is made available for consideration.

Milling of Fairchild aircraft-camera parts presents several problems. As many as eight or twelve flat surfaces have to be cut on almost all parts, both large and small. Trouble is also encountered in attempts to get accurate cuts in milling aluminum and magnesium-alloy castings; on these it is important that the rake of the cutting tool be such that the chips being removed do not become ingrained in the part being machined, and consequently pit or warp the surface.

Through trial-and-error experiments, the fly-cutter idea was adopted. These fly-cutters consist of three separate parts: the fly holder shank, of low carbon steel; the holder, of cold-rolled steel; and the cutter bits, of hard carboloy. Any machinist skilled in tool grinding can make these parts for adaptation to standard shank diameters to fit into any type miller. Fly cutters of various designs and shapes are used for either vertical or horizontal millers and boromatics, or for any desired position or angle. By use of varied length holders for the cutter bits, wide, medium, or short cutting sweeps in any direction can be achieved. Some of the special holders have allowances for slide bits, which can be moved at will along the length of the holder arm until they are adjusted to cut the desired point or points of the casting. They can cut all types of metal castings: Dural, aluminum, and magnesium, as well as brass, bronze, and steel. Three or more bits of alternating heights can be set up on a single machine to accomplish a corresponding number of different cuts simultaneously on the same surface, thereby reducing operating time. For example, in one representative cutter, four separate bits of different lengths do four surface operations. One bit, slightly ahead of all the others, is used to remove the rough surface. The other three, adjusted to alternating shorter lengths, in turn follow through in doing the finishing cuts. The last, shortest bit takes a very fine cut to the desired tolerance and produces a mirror finish Through this multi-fly-cutter setup, as much as $^3/_8$ in. of metal can be removed in a single operation, without warping or distorting the piece.

Pressure exerted by small, single cutter bits is too slight to distort or bend any part of the metal. Such light contact can be obtained with single points going over the metal that friction is cut almost to zero. Thus it is possible to hold closely to tolerances of 0.0001 to 0.0003 in.

Elaborate fixtures to hold the machine in place become unnecessary, as all parts can be held on a flat plate by simple pinch pins because of the absence of heavy pressure from the cutters. Further, by means of various length holders, a range of surface sweep from $^1/_2$-in. swing to almost any area in reason can be achieved. Fairchild's maximum cut is for its 9 in. by 18 in. vacuum back plate used in the model K-18 aircraft camera magazine. The minimum cut is probably that for a taper placed in the aerial sextant.

Because metals are neither distorted nor bent, nor their characteristics changed in the milling operation with a fly cutter, no heat-treating is necessary to restore temper; rejection of parts is kept to a bare minimum; the work is done so fast, with the three or more bits cutting separate surfaces in one simultaneous operation, that machining is speeded up three or more times per piece; the single cutter bit operating at high speed throws the chips free of the piece and eliminates the problem of clogging. Fairchild Camera and Instrument Corporation, New York.

Visual-Dial Snap Gauge

The Federal Model 1330 P-100 visual-dial indicator type of snap gauge enables the inspector to see rather than feel the variations in dimensions. One of its outstanding characteristics is that the weight of the gauge and the operator's hand rest upon the fixed or reference contact and not upon the sensitive contact. The lower anvil is retractable and can be applied to the work without danger of marking fine finishes.

The gauge is adjustable for any measurement up to 1 in. and reads in graduations of 0.0001 in. It is $^5/_8$ in. wide, not over 6 in. long at the longest point, and weighs 15 oz. The contacts are made of Norbide. Federal Products Corporation, Providence, R.I.

Synthetic Foam Rubber

The development of a process to produce foam rubber from synthetic latex has been announced. Because foam rubber previously could be made only from scarce natural latex, substitutes had to be used for aircraft seat cushions, gunner pads, and many similar products.

The new synthetic product can be produced in medium and firm densities, and volume production of it already is under way in Firestone factories. Other war products for which it can be used are tank shock pads, submarine mattresses, helmet linings, and fatigue-pack cushions.

The finished material compares so favorably with the natural foamed latex that Firestone produced before the war that the same name—Foamex—has been given the new product. It is light, odorless, washable, and sanitary, and unattractive to moths or vermin.

The tensile strength of the synthetic material is stated to be equal to or greater than that made with natural latex, and it can be made to remain flexible at temperatures ranging down to −40°F. When soaked in gasoline, the synthetic material increases slightly in volume, but returns to normal when dry. Oil affects it little.

The ability of Foamex made from synthetic latex to resist gasoline and oil, which destroy natural rubber products, will give it many important new aircraft applications. This quality, for example, will make it useful in bumper pillows to protect the hulls of flying boats while they are being serviced by other craft.

Foamex now is available for parachute seats, pilot seats, bombardier seats, and similar aircraft cushions. Firestone Tire & Rubber Company.

Paper Plastic Barrels for Aircraft Rocket Guns

It has now been revealed that the barrels of the "bazookas" which the Army Air Forces have installed on the Thunderbolt and other types of fighter planes are made from a special paper plastic developed by General Electric's plastic division, and the Bryon Weston Company. Plastic was adopted because it is lighter than other types of material and believed to be better adapted for this job.

Firing of the flying bazookas is controlled by the pilot in the same manner as the firing of the 0.50-cal. wing machine guns, by pressing a trigger set in the stick. The bazookas, or airborne rocket launchers as they are called officially, are mounted under each wing, three in a cluster. The weight of the rocket installation is approximately 450 lbs., and the walls of the barrels are about $^1/_4$ in. thick. All six of the barrels may be fired at the same time or they may be fired individually by aiming. The rocket projectiles may also be used as bombs and dropped on a target. General Electric Company.

Spar-Beam Machining Time Reduced

Finishing time in machining aluminum spar beams for airplane wings is reported to have been reduced from $13^1/_2$ hours to 5 min. at a Cleveland aircraft plant, with the help of General Electric Thy-mo-trol. The electronic control unit is installed on a large automatic contour-milling machine designed and built by the Onsrud Machine Works, Inc., of Chicago. The spar must be machined accurately to permit perfect joining of ribs and cap strips, and it must also be contoured exactly to con-

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NEW SF-010

100 Pound
Universal Fatigue
Testing Machine
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1. Tension-Compression 2. Torsion 3. Flexure

Alternating Force Capacity 100 lb
Adjustable in units of 0.2 lb

Maximum capacity in Bending (no preload) 200 in. lb
Maximum capacity in torsion (no preload) 1125 in. lb
Speed of Alternating Force (synchronous) 1800 r.p.m.

Ample space for testing bulky assemblies, easily adjustable for various specimen sizes.

Write for Bulletin 206

BALDWIN PRODUCTS

Hydraulic presses, Testing equipment, Steel forgings and castings, Diesel-electric locomotives, Diesel engines, Metal plate-fabrication, Rolled steel rings, Bronze castings, Heavy machine work, Crane wheels, Bending rolls, Plate planers, Babbitt metal, Alloy iron castings, Briquetting presses.

BLW THE BALDWIN GROUP

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SOUTHWARK

TESTING EQUIPMENT

form with the irregular shape of the wing itself.

The carriage of the milling machine houses four cutter-motor assemblies, providing two horizontal and two vertical cutters which turn at 3,600 and 10,800 r.p.m., respectively, the correct speeds for the aluminum alloys involved. Each cutter is controlled by a follower which travels over a template as the carriage moves from one end of the table to the other. Bed and table are long enough to permit machining the long spar in a single setup. With the four cutters, every type of cut required by the spar-beam design may be made, such as face, slot, and side milling, twist cutting, beveling, and making cutouts for weight reduction.

The need for a flexible carriage-speed control was met by the Thy-mo-trol drive, which assures that the cutters are fed to the work at all times in proper relation to the changing contours of a spar beam. In one pass over the table, the depth of cut may increase and decrease several times. The number of cutters entering the work may change from one to four. Such varying conditions required a change of feed to avoid overloading of the cutter motors. Moreover, a fast "skip" speed was essential to save time when no cutting at all is necessary.

With the Thy-mo-trol system, a.c. power is converted to d.c. to obtain a stepless speed range with a rheostat-controlled d.c. carriage-drive motor. The control device makes possible a carriage feed at any speed from 4 in. to 18 ft., 6 in. per min. This infinitely variable speed within the established limits has resulted in the rapid machining of the complex spar beam.

An automatic cam-bar feed designed by Onsrud engineers makes it unnecessary for the operator to judge the maximum speeds at which the carriage can be fed during the many different conditions encountered in a pass. During carriage feed, a rheostat-connected follower travels over the cam bar, which is contoured accurately in proper relation to the work. Up-and-down travel of the follower as governed by the cam varies the control of the rheostat, and at every point of the pass the mechanically predetermined carriage speed is at the exact maximum that the work will permit. General Electric Company.

Improved Deicer

A new, improved deicer, known as Type II, is reported to have received the approval of the Civil Aeronautics Administration and the Army Air Forces. Many of the new units are now being installed on both military and civilian aircraft. Among the advantages claimed for the Type II deicer are the following: better ice removal, improved tear resistance, nylon tubes, thinner, lighter, and longer-life construction, and reduced maintenance.

Improved tear resistance on the Type II is obtained by an allover ply of special elastic fabric. This same ply encloses the wire bead at the attachment edge, creating a thinner cross section and thereby improving the deicer aerodynamically. Stretchable nylon fabric is now being used in the tubes and these are recessed into the deicer to produce a smooth, uniform cross section. Elimination of reinforcement strips and more effective use of rubber and fabric have reduced the weight of the new construction. Required tension is obtained with less stretching of the material over the leading edge, resulting in less strain on the rubber and longer useful life.

The back of the new device is ribbed, forming spanwise channels between the wing skin and the deicer. These channels are intended to guide any trapped air to chordwise channels and vent holes. They also help to keep lubricating talc spread evenly over the surface. The B. F. Goodrich Company.

Brass Rivnut

The Rivnut—a blind fastener which serves as a nut plate, rivet, or both—is now being made of brass as well as aluminum. Tensile and shear strength of Rivnuts made with the brass alloy are reported to be about 50 per cent greater than those made from aluminum. The B. F. Goodrich Company.

Rubber Belt Can Withstand Pull of Half-Million Pounds

Intended for use with a machine for testing airplane tires and brakes, a rubber belt with a steel-cable carcass has been developed. It is reported that this belt, when looped, can withstand a pull of more than a half-million pounds. Its weight is more than 2,700 lbs. Construction of the belt was made possible because special steel cables were used in place of piles of cotton fabric for the frame. It is claimed that this belt can be loaded to about seven times the tension of the heaviest belt ever made before. Goodyear Tire & Rubber Company.

Chemical Lacquer for Propeller Deicing

A chemical deicing lacquer for aircraft propellers, now being manufactured under the name of Icelac, is painted or sprayed on propeller blades, and by means of chemical action affords protection from icing conditions for long periods of time.

Icelac is black in color, has a consistency about equal to that of glycerine, and paints or spreads freely, drying with a shiny tacky surface. It is stated that a satisfactory surface can be maintained on blades with little or no maintenance, giving protection down to temperatures well below 0°F.

Ice-releasing chemicals in the compound eventually become exhausted in the film, the condition becoming apparent when the substance loses its sheen. Additional coats are then applied. Under favorable weather conditions, it is stated, the lacquer lasts hundreds of hours, although a sustained flight under adverse conditions, such as a heavy rain followed by severe icing, may require renewal after completion of the flight.

Several advantages are claimed for Icelac over the slinger-ring system. First, it does not require fluid, so that the possibility of exhausting a supply is eliminated. Next is the saving of weight. The slinger-ring system weighs 10 lbs. for each propeller and requires another 10 lbs. for fluid for each hour it is in operation. The chemical deicer has a weight of only 4 oz. for each propeller, so that on long flights of large planes the saving may exceed 100 lbs.

Further advantages of the chemical deicer are its simplicity, the fact that it needs no attention from the flight crew, and that it may be applied in the field or under adverse conditions without preparation or special skill.

The film of Icelac, sometimes applied to the entire blade and sometimes only to the leading edge and shank, is about $^{5}/_{1,000}$ in. in thickness. The procedure of application is as follows: The first step is to remove all grease and dirt from the blades by washing them thoroughly with turpentine. A special primer is then sprayed on unpainted blades, followed by two thin coats of Icelac after the primer dries. On black war-painted military blades no primer is used and three coats of Icelac are sprayed or painted on. The whole process takes approximately 1 hour. The preparation may be removed by soaking with gasoline and rubbing with a dry cloth, leaving the paint or primer unharmed. Hamilton Standard Propellers, Division of United Aircraft Corporation.

Special Scale for Static Balancing of Propeller Blades

One of the latest products for the use of the aviation industry is a scale for the static balancing of airplane propeller blades to precision limits. With this scale, all blades can be brought to a standard balance, thus facilitating the assembly of new propellers and making it possible to replace broken blades immediately at field bases.

Precision balance is obtained by inserting the butt end of a blade into a clamping socket on the scale until it touches two contact stops which are set the same distance from the fulcrum pivot as the butt would be from the center of the hub of the propeller shaft. Two lamps light up to indicate when the butt end is located properly. A lever and lifting arrangement eliminates manual handling of weights, a graduated indicator permits extremely accurate readings, a special mechanism locks the lever in position when not being used, and a relieving device raises the fulcrum knife-edges off the bearings for protection when blades are being mounted or removed. Six counterpoise weights make it possible to balance various-sized blades on the same scale. Howe Scale Company, Rutland, Vt.

Aircraft-Engine Preheater

An aircraft-engine preheater designed to hang conveniently on the propeller

of a radial engine, and small enough to be easily handled by one man (weight about 45 lbs.) is the latest model announced by a maker of direct-gasoline-fired heaters. The new unit, which measures 18½ in. by 5½ in. by 13½ in., is rated at 40,000 B.t.u. per hour. It is equipped with an air-snug canvas hood to enclose the engine, and short connecting ducts for hot and return air.

In recirculating air within the enclosure, which includes all engine parts, the Hunter heater employs a new principle according to the manufacturer. Advantages claimed are concentration of heater output into useful application of heat to the engine parts. Because of the short travel, a minimum of heat is lost through ducts and connections. One heater is applied to each engine.

The same heater can be used for preheating aircraft cabins, for heating small offices or shops, or for throwing a flow of warmed air around a mechanic working in an unheated area. Basically, the new unit is the same as previous heaters from the same manufacturer, which have been in successful use on aircraft in extremely cold areas. Components are a simple welded-steel burner with "Sealed-in-Steel" flame; a small blower which drives the heated air and also furnishes forced draft for combustion; a built-in fuel tank, and controls centered on a small panel at one end of the heater. Ducts and hoods are available to fit all sizes and types of radial engine installations. Hunter & Company, Cleveland.

Induction-Heating Apparatus

A general-purpose two-station hardening and quench table, used in connection with high-frequency induction heating generators, is offered for use with a wide variety of machine parts requiring surface hardening or localized heating.

Arranged with quick-change coil connections so that jobs can be set up in 2 to 3 min. to change a heating coil, it is only necessary to make two coupling connections to the leads located at each outlet station. The makers state that the device will handle a wide range of work and can be used either as a single-purpose unit, using two identical fixtures, or it will serve as a general-purpose table for various kinds of hardening operations, even where the lots may run as low as 6 or 12 pieces.

An initial timer is provided so that when a new part or new job is to be induction-treated, the heating time will be recorded or indicated, eliminating the need for a stop watch or other means of timing. After the initial heating time has been determined, the timer can be cut out by means of a selector switch included in the time assembly. The table is equipped also with a master 3-stage timer, located at the front, which automatically controls the heating and quenching positions of the cycle. It is possible to arrange for a slight delay between the heating and quenching sequences, for the hardening of such parts as may require this type of treatment.

Hose connections are provided at the front of the panel, which in turn connect to quench rings that surround the part being heated, permitting a spray quench to be applied. The duration of the quench is controlled by the master timer that operates a solenoid valve. Spray quench of selected periods can be applied, so that specific control of hardness readings can be obtained, thereby often eliminating the need for additional drawing or tempering operations.

Two rotary-driven spindles are provided for use in connection with the hardening of parts such as gears, where a slow rotary motion assures uniform heating. Rotation of work pieces often eliminates the necessity of precision-made coils or in cases where uniformity of coil coupling may normally be needed. The spindle control includes a selector switch for each spindle so that rotation can be cut out in cases where rotation is not needed. Other modifications of the combination hardening and quenching tables are available, including one in which the work-rotating spindles are omitted and another where only one spindle is provided.

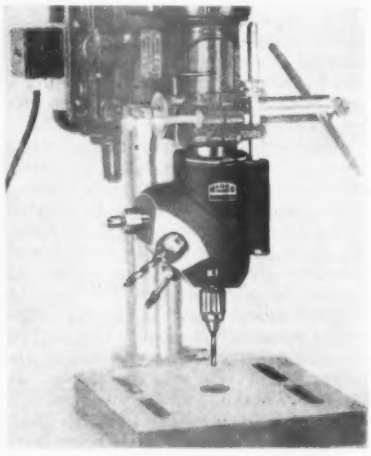
A change-over switch located on the front panel is used to engage either work station. With the switch thrown to the left, for example, the left hand coil outlets are connected and when the integral push button is engaged, that side is energized. A signal-type pilot light automatically is turned on indicating that heating is taking place. At the end of the cycle the pilot light automatically goes off, showing that the cycle has been completed. Induction Heating Corporation, New York.

Distributor Tester

The Isotronic-Distributograph Model 500 serves to diagnose the electrical and mechanical action of aircraft or automotive distributors, to show the need for adjustment or replacement with reference to point action, adjustment, and wear.

A distributor is positioned in an adjustable arm in this new testing equipment and is connected to a variable-speed motor beneath the panel top for rotation under rheostat control at any speed to 2,500 r.p.m. Surrounding the driving shaft is a movable scale ring graduated in degrees for either direction of rotation. In the housing is a power pack for operation of electronic tubes employed in the test. A tachometer shows the speed of rotation and a switch controls the direction. A vacuum pump and gauge are included for application to the vacuum-advance mechanism when this is a part of the distributor. The mechanism is built into a welded-steel housing. A lamp on a flexible extension illuminates the distributor.

A disc in the center of the panel rotates with the distributor shaft and carries two electronic tubes, one red and one blue. The tubes are mounted at 180° intervals and light each time the distributor contacts close, the lighting occurring at the same position on the circular scale if the distributor is in good condition. The tubes produce a red light bar at each firing-interval point, the red light making the blue light invisible. A worn camshaft or bushing will light the blue tube out of phase with the red one, so that both red and blue bars will be visible. The number of degrees in the arc between the two give a reading of the error. The actual number of degrees of cam travel during which the points are both open and closed is read by turning a switch and noting the reading between the light bars on the scale. Lanagan & Hoke, Inc., Philadelphia.



The Machine Development Company's drill press turret head.

Drill Press Turret Attachment

The Madco turret head, a newly developed turret attachment for small-type drill presses such as those produced by Atlas, Buffalo, Delta, Walker-Turner, etc., is designed to enable single-spindle drill presses to be used for multiple-spindle operations. The present model carries six individual spindles and will take up to ⅜-in. diameter drills. It can also be used for tapping when a drill press is equipped with a reversible motor.

Installation is simple and quickly accomplished. The unit is attached to the lower end of the drill-press quill by means of a collar that is locked in place with three set screws. The only change necessary in the drill press is the removal of the chuck, which is replaced with a special driving mechanism supplied with the turret attachment. By means of a clutch arrangement, the individual spindles are driven in proper alignment with the main drill-press spindle.

When the turret head is in operation, a worker merely has to raise the drill press lever, turn the head to any station he desires, and then lower the lever as in a normal drilling operation. A ball and detent arrangement indicates to the worker when the head is indexed to the correct position and the special clutch device automatically engages and aligns the spindle for drilling.

Caught in the Widow's Web . . .

Boring into the inky blackness, the P-61 Northrop Black Widow ferrets out the enemy with an electronic eye and delivers a torrent of cannon and machine gun fire.

As hefty as a light bomber, but with the agility of a single seat fighter — that's the "Black Widow." Like most other outstanding U. S. fighters, the P-61 uses Curtiss Electric Propellers.*

* P-38 Lightnings, P-47 Thunderbolts, P-40 Warhawks, P-51 Mustangs, P-39 Airacobras and Navy F4F and FM-2 Wildcats.

CURTISS ELECTRIC PROPELLERS

Curtiss-Wright Corporation · Propeller Division

Mark of *Dependability*
Shield of *Protection*

Breeze Radio Ignition Shielding Guards Radio Communications Against Natural and Man-made Interference

The Breeze Mark on Radio Ignition Shielding has for sixteen years been a mark of dependability, symbolizing the quality workmanship and engineering skill that has gone into every Breeze Shielding Harness. Designed for use on hundreds of different types of engines, this shielding has been developed by Breeze engineers to eliminate the radiation or absorption of high frequency interference in radio communications. In addition to this important function, durable protection is afforded to secondary wiring systems by Breeze Flexible Shielding Conduit, which guards against moisture, corrosion and abrasion.

Now in service aboard aircraft, ships and tanks of Allied Liberation forces, this equipment is the result of years of Breeze experience in the field. With its unequalled background of research and production, Breeze has acquired the knowledge and ability required to solve any shielding problem.

Breeze BREEZE MARK
CORPORATIONS, INC. NEWARK, N. J.

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Radio Ignition and Auxiliary Shielding
Multiple Circuit Electrical Connectors
Flexible Shielding Conduit and Fittings
Cartridge Engine Starters
Internal Tie Rods
Elevator and Rudder Tab Controls
Flexible Shaft and Case Assemblies
Aircraft Armor Plate

The turret head can be equipped with either six "screw chucks," which are furnished blank so that the user may drill them for his own particular tool applications, or six adaptors for No. 1 Jacob chucks, or a combination of both. Available at slight additional cost are adaptors for Nos. 2 and 3 Jacob chucks, an automatic indexing depth stop, and an adaptor collar which enable the turret head to be attached to a 17-in. Delta drill press. Machine Development Company, New York.

Simple Layout Tool

The laying out of production tools for the Martin JRM Mars has been greatly expedited by a new, easily constructed layout tool.

Designed to facilitate sheet-metal layout work where it is impossible because of irregular contours to use the sides of the sheet as a working edge, the device makes it possible to locate points readily and to erect vertical and horizontal lines in reference to a base line scribed on the surface of the work. It consists of two bars with accurately spaced tapped holes along their length, which pivot around a bushing. On each bar is a block with a groove into which the bar is recessed, and a hole to accommodate a dowel pin with a slip fit. The blocks are secured to the bars by thumbscrews passing through a slot in the block and engaging the tapped holes.

To lay out a line with the new device, a base or reference line is scribed on the work, holes are drilled along this line at widely spaced points, and dowel pins are fitted therein with a pressed fit. The blocks of the layout tool are then placed over the dowel pins and position A is located by placing the thumbscrews along the slots in the blocks, after which the screws are tightened. Position A is then marked with a scribe or drill through the pivot bushing at the joint of the bars.

Next, one bar is removed from the dowel pin and the bars are hinged in the opposite direction. This locates position B, which, when connected to A, gives a line perpendicular to the base or reference line. To erect other perpendicular lines spaced accurately from the first line, it is merely necessary to loosen the thumbscrews and make adjustments either by sliding the screws in the slots or moving them to new holes.

By drilling two holes along any vertical line and inserting dowel pins, the tool may be used to draw other lines parallel to the base line. Thus the need for squaring an edge of the work or similar time-consuming procedures are completely eliminated, since it is possible to locate points anywhere on the layout surely and accurately by rectangular coordinance. The Glenn L. Martin Company.

Rapid Glue-Curing Device

Operating on the principle of direct application of heat, a new glue-curing device designed by woodshop employees now cuts down the time required to cure ammunition boxes for the Martin PBM from 3 hours to 15 min.

By the old method it took two men with three jigs to make 10 boxes in 24 hours. Boxes were assembled on the jigs and baked in a curing oven for from 2 to 4 hours. The high cost of making extra jigs, tooling time involved, lack of extra personnel, and shortage of space in the curing oven prevented the wood shop from making more than a few boxes at a time.

The new device is made up of two jigs. On one are assembled the tops and bottoms of the ammunition boxes. The bottom is then placed on the second jig where the four sides of the box have been assembled, and angles are glued to the corners, the device is closed, clamps are placed in position, and pressure screws are turned, forcing parts of the assembly to be pressed solidly to the heat box. This assembly is then cured for 15 min. and the operation is completed.

The 220-volt electric air-strip heater used is completely enclosed in refractory material, encased in a steel sheath, and covered with Masonite to provide 120° heat without scorching the wood. Heat is thermostatically controlled so that low temperature is maintained throughout the curing process. This method of heating is found to be less expensive than the use of high frequency.

Other advantages of the new devices in addition to timesaving are that the assembly can be observed during the curing cycle, and there is uniformity of glue after curing because of the temperature control. The process is applicable to the assembly and fabrication of devices made of wood, plywood, Masonite, etc., wherein the attachment of one part to another is performed with resinous or synthetic glues that must be cured by the application of heat in the process of manufacture. The Glenn L. Martin Company.

Short-Range Transport Airplanes

A short-range, 30-passenger, twin-engined transport designated as Martin Model 202 has been designed to meet what is known as the A-1 specification of the Air Transport Association for short-haul, postwar passenger and cargo aircraft. Preliminary data and drawings of several different versions, together with a complete engineering study covering operating costs, aerodynamics, weights, and wing loadings, have already been submitted to the air lines and A.T.A.'s Aircraft Requirement Committee.

Basic models are the 202–11 and 202–12, which are low- and high-wing versions respectively, designed around the Wright R-2600 engine. A model 202-15 offers a somewhat higher gross take-off weight and one-engine operational ceiling with approximately the same ratio of useful load to normal gross weight. All three of these versions are designed to meet all requirements for an ATA-A1 airplane except the size of airport from which they must operate. It was found that the most economical airplane had a wing loading that required a 3,250-ft. airport at sea level. However, with a slight decrease in wing loading, the 3,000-ft. airport requirement can be met with a very small change in operating cost. Furthermore, four additional designs provide high- and low-wing versions to operate from 2,900-ft. and 2,500-ft. runways, although at some sacrifice in overall economy.

A 30-passenger airplane was chosen as the most likely size for an A-1 transport, but general design parameters and features would remain the same should a smaller airplane be desired. Likewise, while all models except the 202-15 were designed around the Wright R-2600 engine, any one could be modified to take the Pratt & Whitney R-2800.

From the standpoint of speed and economy, the Model 202 with a wing loading of 44 lbs. per sq.ft. is the most efficient. This airplane will cruise at 250 m.p.h. at 10,000 ft. and 60 per cent power. Other versions with lower wing loadings and comparatively low stall speeds can be built, but the result is a comparatively expensive airplane, according to the builder's studies.

On the Model 202 the designers have likewise attempted to evaluate the comparative merits of high-wing and low-wing aircraft, and both high and low versions are offered at each wing loading. The high-wing airplane appears to present certain advantages such as passenger visibility, ease of loading and unloading, and reduced ground time, whereas the low-wing airplane offers others, such as a shorter landing gear and reduced "empty" weight. On the Model 202, to make the high-wing version safe in "belly" landings, 200 lbs. of structure has been added in the form of longitudinal beams in the bottom of the fuselage, while heavy bulkheads are included under each spar to support the wing in the event of a crash landing. The net result is a 382-lbs. greater weight for the high-wing version, amounting to 3.85 per cent of pay load plus fuel plus oil. Offsetting this, the high-wing airplane will cruise 4 m.p.h. faster because of its smaller fuselage frontal area.

Features of the Model 202 include many provisions for the easy handling of passengers and cargo. Cabins of all versions are convertible to passenger, cargo, or combined passenger and cargo operation, and are equipped with a movable bulkhead utilizing standard loading-gear fittings. Seats are so designed that for cargo operation seat cushions are stored in overhead luggage racks. Hatches on all versions are below truck level to simplify loading. Two interior arrangements for passenger service are offered, one with all seats facing forward in the manner of present day air liners and the other with opposed seats. Both arrangements provide a luggage compartment beside the entrance hatch for passengers' hand luggage, making it available at all times.

The Model 202 has a design gross weight of 32,500 lbs. for all versions, ex-

These Light, Structurally Strong HASKELITE MOLDED PARTS Simplify Production of Airflow Designs

There's just no end to the production problems Haskelite Engineers have helped to solve with large molded parts using combinations of wood veneer, thermo-setting resins, contact resins, cloth, glass cloth and paper.

These Haskelite laminates are in successful use for military and civilian purposes. Their performance records under long and grueling practical tests are, in many cases, exceeding engineering expectations.

Structurally strong . . . and extremely light . . . these products can be used to produce airflow designs easily and economically . . . can be made gas tight and impervious to common liquids.

Our production and engineering facilities may be of help to you in producing your large molded parts. Our services are available to you.

Permit Combinations of Wood Veneers, Thermo-Setting Resins, Contact Resins, Cloth, Glass Cloth, Etc.

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cept the 202-15 which is 33,500 lbs., and is designed for an average operating range of 500 miles carrying a 50 per cent fuel reserve. The crew consists of pilot, copilot, and stewardess.

A cost analysis shows that direct flying costs for the 202-11 and 202-12, operating over this range at 60 per cent power, will come to $117.31 per hour, divided as follows: fuel, $25.40; oil, $1.38; plane depreciation $7.76; engine depreciation, $3.07; engine overhaul and repair, $7.37; plane overhaul and repair, $6.49; plane and engine ground service, $7.20; first pilot, $11.10; copilot, $5.60; cabin attendant, $2.29; crew expense, cockpit, $1.02, cabin, $0.78; plane insurance, $4.29; passenger service, $33.90. Direct flying cost per mile is calculated at $0.519, and direct flying cost per ton-mile at $0.154. The Glenn L. Martin Company.

Plastic Aileron Quadrant

One of the more unusual applications of plastics to aircraft is the aileron quadrant on the B-26 Marauder used in connection with a cable drive to activate the ailerons. The part is compression-molded from macerated fabric-base phenolic (celeron), and weighs 7.11 lbs. This same part was originally designed in aluminum alloy and weighed 7.985 lbs. Not only is the new plastic part lighter than its aluminum counterpart, but in addition outwears it. The Glenn L. Martin Company.

New Composite Structural Material

The "plastic sandwich" is a new composite material developed in the Martin Structural Plastics Laboratory. In its first production application, a loop-antenna mounting plate for the PBM Mariner, it has resulted in a 32 per cent weight saving, a 60 per cent saving in tooling costs, and a 50 per cent reduction in overall cost.

Made up from a high-tensile surface material and a resin-impregnated woodpulp core, the plastic sandwich can be given varying properties of strength, weight, and density as desired, through the proper selection of material for the outer plies and resin filler for the core. It can be easily molded to irregular shapes, and can provide special integral high-density areas for special stresses, such as the attachment of fittings without sacrifice of lightness or strength. Structural as well as non-structural applications for the new material are now in the experimental stage.

Advantages of the composite plastic are well illustrated in the Mariner mounting plate which provides a bearing surface for the loop antenna located aft atop the hull. The top surface of this plate is flat but the bottom is concave to conform to the contour of the hull.

Normally this part would have been machined from phenolic fiber plate with the radius milled out by a convex cutter approximately 6 in. wide and specially ground to the required radius of $25^{7}/_{16}$ in. Three such tools would have been necessary to provide spares in case of tool breakage. Through the use of the new material the need for these tools was eliminated and a substantial weight saving was achieved in addition.

The parts are molded in the following manner. First, the core consisting of two sheets of resin-impregnated woodpulp is sandwiched between built-up plies of resin-impregnated facing paper in a box-like jig and the whole assembly is stapled together to facilitate handling. The assembly is next placed in a kirksite die providing the required radius, covered with a flat pressure plate, and the die is placed between electrically heated platens in a hydraulic press. Heated to a temperature of about 300°F., the resin in the composite plastic flows as pressure of 5 to 10 lbs. per sq.in. is applied. Each molded part is left in the press for a short interval to cure while the next assembly is being constructed.

Subsequent machining operations are similar to those required for parts made from phenolic fiber plate. The rectangular sheets are placed in a router board and cut to the desired oval shape. After the edges have been sanded, attaching and locating holes are drilled in a jig. Later, holes of various sizes are fly cut on the inner surface of the plates to allow passage of the antenna wiring.

This composite plastic is procurable in specific gravities ranging from that of spruce and poplar wood to that of laminated phenolic plate, which is about half the weight of aluminum. In addition to impregnated paper, materials successfully employed for the face plies include aluminum alloy, phenolic sheet, Fiberglas, fabric and others. The Glenn L. Martin Company.

Some Non-Confidential Problems Approved for Publication by the Army Air Forces

The August, 1943, and June, 1944, issues of the AERONAUTICAL ENGINEERING REVIEW published lists of devices and methods needed for the war effort, for which suggestions and solutions were invited by the National Inventors Council. The War Department has now authorized the release of a third list of that kind comprising problems the solutions of which would be helpful in the prosecution of the war. This group originated with the Army Air Forces and contains problems peculiar to their existing needs.

It should be realized that partially satisfactory solutions to most of these problems are already available. However, there is always need for, and interest in, an original and inventive approach. Ideas directed toward the solution of these problems should be submitted to the National Inventors Council, Department of Commerce, Washington 25, D.C. They will be promptly analyzed and those that appear novel and promising will be placed in the hands of appropriate military personnel. The following is the list of subjects on which suggestions are desired:

(1) A lightweight, reliable, simply installed thrustmeter for aircraft installation, combined with a torquemeter if possible.

(2) A shock absorber that does not require the use of synthetic packing to retain the fluid in the strut.

(3) Shimmy-proof, free-swiveling castered wheel and tire.

(4) An accurate, simple cable-tension reading instrument.

(5) A control cable having a coefficient of expansion close to that of aluminum alloys used in aircraft structures, or an equivalent mechanism that will take up cable slack.

(6) A high-precision, low-friction bearing that does not involve the use of balls or rollers.

(7) The development of a suitable shock mount to permit the installation of a gun camera on an 0.50 cal. machine gun, to permit the photographing of objects during the time that the gun is being fired.

(8) Small, lightweight gasoline engine, either 2- or 4-cycle, capable of reasonably continuous operation utilizing 100-octane aviation gasoline, which may be started and operated at temperatures as low as −65°F. Rating should be between 1 and 5 h.p.

(9) An independently operated heating unit for sea-level operation, capable of continuous operation at −65°F. for a period of 8 hours. Unit should weigh not more than 1 lb. per 1,000 B.t.u. per hour output, and must deliver clean and nontoxic heated air.

(10) A liquid or paste, good for at least 12 hours' service, which will prevent the formation of ice on airplane surfaces.

(11) To determine methods of fabricating quartz hairsprings and diaphragms for use in watches, aneroid barometers, altimeters, airspeed indicators, and rate-of-climb indicators.

(12) A device for the quick release of a cargo parachute from the cargo upon contact of the cargo with the ground. This is desirable to prevent the dragging of the cargo on the ground.

(13) Positive parachute-opening device, to provide automatic opening at a definite altitude above the ground.

(14) Improved form-fitting, flexible, comfortable parachute pack, of reduced weight and bulk, and with tendency toward premature release eliminated; improved wearing qualities also are desirable.

(15) Harness having improved quick-releasing hardware, giving reduction of weight and bulk and increase in comfort.

(16) Low-cost aerial-delivery parachutes. Must withstand 200 m.p.h. airspeeds.

(17) Parachute-drop test instruments; load recorder for parachute openings; means for controlling precise time of opening and rate of descent.

(18) Parachute-canopy redesign to reduce weight and bulk without impairing present performance.

★ **Protecting** the vital operating parts of engine crankshafts; superchargers, and inertia starters are the dependable Hyatt Roller Bearings...into which we build great stamina and capacity, while holding them true to required precision tolerances...

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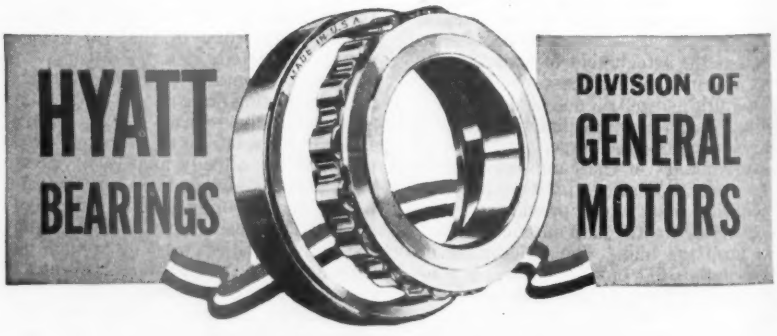
Hyatt roller bearings are built to last—and require a minimum of care. But don't forget to give them the proper attention all precious anti-friction bearings deserve today.



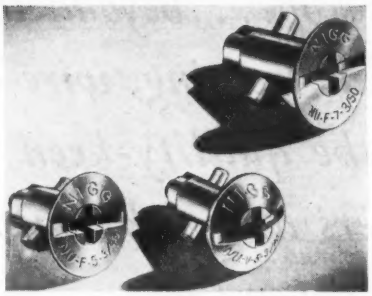
HYATT BEARINGS DIVISION · GENERAL MOTORS CORPORATION · HARRISON, NEW JERSEY

(19) A stable parachute, equal in strength and simplicity of construction to present hemispherical type.
(20) A release and exchange mechanism for two targets suitable for exchanging targets without loss of equipment at high speeds.
(21) A tow-target "hit indicator" to indicate hits and the direction and magnitude of misses, for fixed, flexible, and turret aerial-gunnery practice fire.
(22) A tow target capable of being towed at high speeds and producing a low drag.
(23) An extra-flexible, high-strength, 1/8-in. diameter, target-towing cable that will not "birdcage."
(24) Machine for running breakdown experiments on heating elements incorporated in electrically heated flying clothing. Clothing includes jackets, trousers, gloves, and shoes.
(25) Design for dependable thermostats for control of clothing heaters to operate on d.c., and small enough to be used in gloves and boots.
(26) Development of an electroplating method for the deposition of a lead-indium alloy containing approximately 4 per cent indium.
(27) Development of methods or apparatus for establishing the quality of glue joints in wood without testing to destruction.
(28) Development of a material with the electrical properties and heat-resistant characteristics of mica.
(29) Automatic ground-speed measuring devices.
(30) Compact, light, and durable two-speed or variable drive for geared superchargers.
(31) Shockless two-speed propeller-drive mechanism.
(32) Practical variable-diameter propeller to give maximum performance at S.L. and extreme altitude.
(33) Practical two-position or variable-compression ratio control.
(34) Simple and light detonation indicator for installation in airplanes. The National Inventors Council, Washington.

Universal Fastener Stud

The Nigg fastener stud is reported to have been officially approved for use on both U.S. Army and U.S. Navy airplanes. The new universal stud is adjustable to all sheet thicknesses from 0.021 in. to 0.500 in. It meets the proposed AN-F-8 specifications, the AN-228 Drawing and Air Service Command requirements, and is stated to exceed by more than 50 per cent the specified tension and shear loads.

The stud can be used in all standard pin-type receptacles—Right Way, Chicago, Shakeproof and United Carr. The fastener is available in −7 flush-head and −5 oval- and flush-head sizes. United-Carr Fastener Corporation, Cambridge, Mass., has been appointed sales representative for the entire United States except California, Oregon, and Washington. Nigg Engineering Company, Covina, Calif.



The Nigg universal fastener stud.

"Retractable Ailerons" on the Black Widow

Retractable ailerons have been disclosed as a feature of the P-61. Designed to replace conventional ailerons and permit use of full-span wing flaps for increased air-braking power, these devices are long, scoop-shaped metal strips dotted with holes. They are mechanically attached to two small conventional-type ailerons located at either wing tip of the plane. When not in use they are concealed in slots near the trailing edges on the outer wings of the plane.

In using the retractable ailerons to turn the plane in the air, the pilot operates the controls as heretofore. As he does so, the ailerons raise from their slots and the scoops "spoil" the airflow, almost instantaneously eliminating the lift of the wing. It is claimed that through their use the pilot can turn the Black Widow very sharply while in full flight, without danger of immediate stalling.

Design of the retractable ailerons resulted from the use of full-span wing flaps with which the P-61 is equipped. Conventional-type ailerons take up much of the trailing surface of airplane wings and the new equipment was devised in order to utilize as much of the wing edge as possible as a braking surface. Northrop Aircraft, Inc.

Veteran's Placement Program

Under a special program, which has been successfully tested for employing returning war veterans, a department has been set up to handle the specific problem of "fitting the job to the man," so that the veterans, discharged from the armed services, can continue the job of helping win the war and at the same time re-establish themselves in their chosen industrial field.

The Northrop Veteran Placement program, separated from the regular hiring process to give special consideration to the veterans, has been placed in charge of a veteran of four years in the A.A.F.T.C., three of which were spent as a squadron commander in the training of army pilots. With this background of army life and servicemen's problems is coupled the director's training as an industrial engineer. Specifically the new department considers the veteran's previous background, his skills and aptitudes, and his physical handicaps. Personne representatives and the returned serviceman select a suitable job and adapt it to fit the man.

In addition, the department works as the veteran's "special representative" in problems of re-establishing his home, obtaining transportation to and from work, and in handling any "unfinished business" he may have with the Government in connection with his military service. The program applies to veterans of all branches of the armed services. Veterans placed through the Northrop program include men from practically every theater of operations and every branch of the service. Northrop Aircraft, Inc.

Power Brush Cleaning of Spark Plugs

Among the uses for power brushes in the aviation industries, one of the most important from the standpoint of timesaving concerns the cleaning of spark plugs. Timesavings up to 75 per cent over former hand-brushing methods have been reported by one large midwestern engine builder. Not only does the power-brushing application speed up the work, but a better cleaning job is effected, thus eliminating possible replacements or extra servicing.

A metal-tape section brush made of 0.005-in. diameter wire is revolved at a speed of 3,450 r.p.m. by a bench-mounted electric motor of 1/3 hp. After the aircraft engines complete their test runs, the spark plugs are removed, held against the brush and rotated by hand so that all outside surfaces are thoroughly brush-cleaned. The entire operation requires only 15 to 20 sec. as compared with about 1 min. per plug with former hand scratch-brush methods. The Osborn Manufacturing Company, Cleveland.

Self-Flaring Coupling for Plastic Tubing

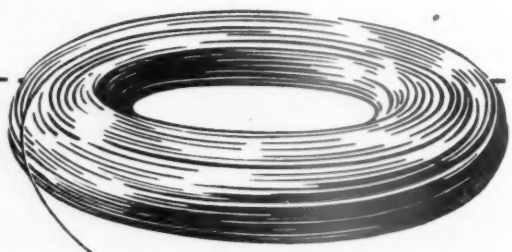
No flaring tool is required for use with a new self-flaring coupling for flexible plastic tubing. The flare is formed as the members of the coupling are screwed together in one simple operation, assuring uniform-walled flare, with no thinning toward the end to weaken the tube. The plastic tubing is not preheated. It is stated by the manufacturers that the construction, by providing a union effect, eliminates twisting and distortion of the tubing as well as split ends during installation.

Only the simplest of shop tools are required and assembly may be made directly at the job. The couplings may be reused many times. They are made for tube sizes 1/4-in. to 3/4-in. outside diameter. Packless Metal Products Corporation, New Rochelle, N.Y.

Decimal Point Locator and Slide Rule

A decimal-point locator and slide rule has been devised to determine the decimal point mechanically in involved expressions with results up to 19 places. It is stated that the scale arrangement gives 30-in. accuracy for cube root and

Beyond a slide rule's scope . . . beyond the multi-mechanical factors of rolling, heat treating, wire drawing, and final fabrication . . . are the quality-keen minds of Roebling researchers, engineers and fabricators. That's another reason why you can depend on . . .



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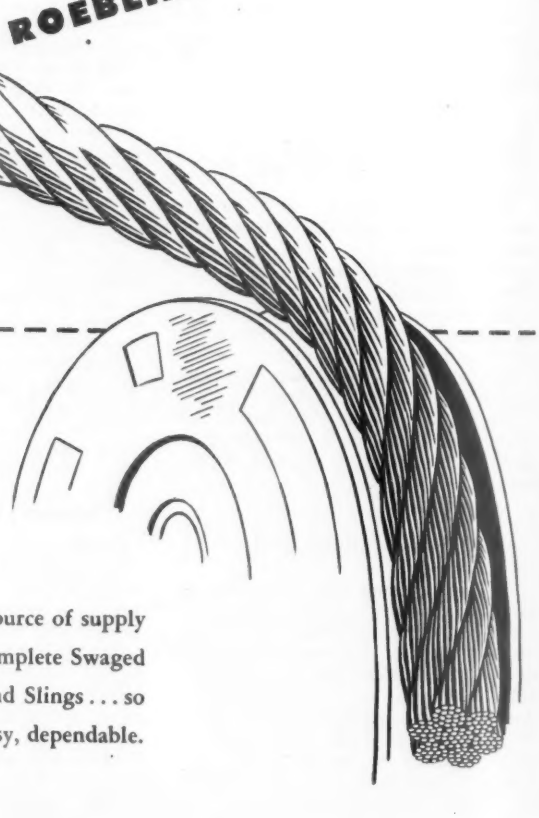

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That's why you may look to Roebling as a responsible source of supply for your needs in Control Cord and Strand, Terminals, Complete Swaged Assemblies, Control Casings, Special Wires and Cables and Slings . . . so that controls on the ground—in the air—will be positive, easy, dependable.

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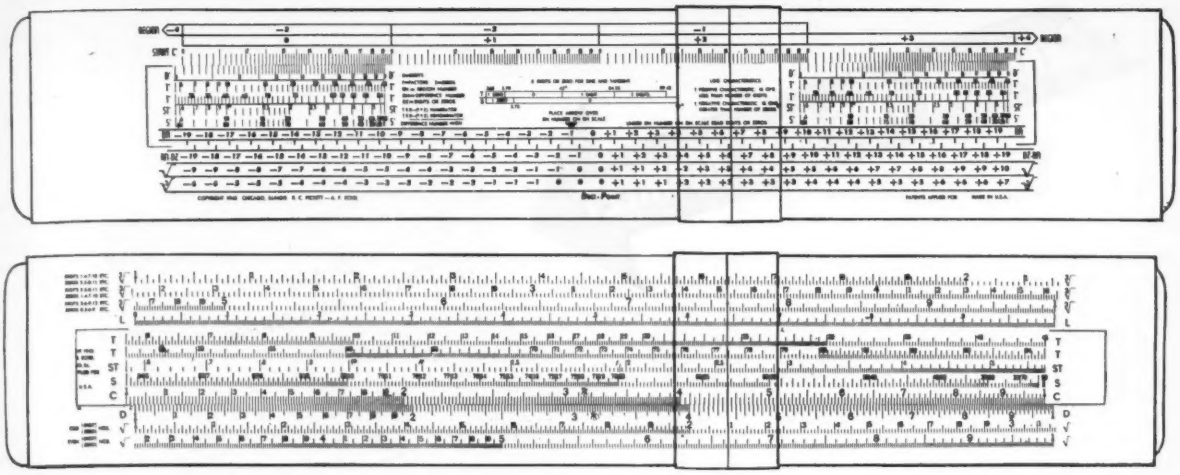

The decimal point locator and slide rule determines the decimal point mechanically in involved expressions with results up to 19 places.

20-in. scale accuracy for square root. One setting of the hairline enables the computer to read square root, cube root, and logarithm. One setting of the hairline also determines the decimal-point location for square root and cube root.

The device so simplifies slide-rule calculations that persons with a very limited mathematical background can evaluate and point off problems containing cube root, square root, log, and trig. factors.

The illustrated instruction manual, written by M. L. Hartung, Associate Professor of the Teaching of Mathematics at the University of Chicago, gives instructions for beginners, rules for operating the decimal-point locator, and presents the mathematical theory of mechanical decimal-point location. Pickett & Eckel, Chicago.

Cooperative Research Program for Long Island

A program of joint research on major problems, and possibly an exchange of facilities and personnel, may be developed as a result of a survey of the facilities available in the Long Island district. Such an inventory of testing and research equipment was undertaken to help delineate the engineering subject matter to be discussed at future meetings of a group of engineers connected with Long Island aeronautical companies. The fields to be investigated may include air frames, aerodynamics, flight testing, metallurgy, instruments, engines, propellers, radio, ignition, carburetion, and operation.

The new organization will provide for the aviation industry on Long Island a conference similar to that inaugurated some 7 years ago by the California Institute of Technology in association with the leading engineers of west-coast companies.

The principal role of the Long Island Aeronautical Engineering Conference is expected to be in coordinating the development work which actually is just beginning in many phases of the airplane industry. At the present time the surface has barely been scratched in new fields, such as the development of the flying wing and jet propulsion, and, to a certain extent, structural design. It is expected that general types of planes may be changed for certain uses. Many different types of planes will certainly be available following the war.

There is particular need for development in research to solve certain problems dealing with the ignition systems and magnetos on aircraft engines. It is felt, too, that there is a need for closer cooperation, particularly in the postwar era, among the air-frame manufacturers. In the eastern seaboard area there are no wind-tunnel facilities for the testing of large models. Through the Conference and the cooperation of its members it may eventually prove possible to have a suitable wind tunnel.

Among the subjects already discussed are: equipment for hydraulic research and testing, instrument testing, flight testing, equipment for studying engine-cooling and supercharging problems, for testing ignition and magneto systems under various atmospheric conditions, and aerodynamic structural equipment. On the basis of the equipment inventory the Conference will decide the mutual research problems that will be undertaken. Dr. R. Paul Harrington, head of the Department of Aeronautical Engineering of Polytechnic Institute of Brooklyn, is Chairman of the executive committee of the Conference.

Polytechnic Institute is carrying out contracts for research in aeronautical engineering, mainly with the National Advisory Committee for Aeronautics. Ten contracts for research have been granted to date by the N.A.C.A., and others are pending in aerodynamics and aerostructural problems. While the research has been mainly of an analytical nature, a great deal of experimental work has been conducted, necessitating a corresponding development of laboratory equipment. Polytechnic Institute of Brooklyn.

Gliding and Soaring Conference

Two developments, stated to be the first of their respective kinds, involve a sandwich-constructed rudder for a motorless plane and a jet engine as a launching device for motorless planes. These were demonstrated as a feature of the motorless-flight conference of the Soaring Society of America, Inc., at the Polytechnic Institute of Brooklyn on August 5 and 6.

In this first public demonstration of jet launching for gliders, the engine, mounted on a restraining structure, was started and allowed to run for some time. The demonstration of this pioneer development was presented in conjunction with a paper on the "Problems of Applying Reaction Propulsion to Gliders," by Zbigniew Krzywoblocki, Fellow in Aeronautical Engineering and instructor at the Polytechnic Institute.

Zygmund Fonberg, a consulting engineer credited as the inventor of the "bazooka" rocket gun, built the full-scale model especially for the conference. It was constructed according to the specifications of the Fonberg jet engine, which he developed in Poland where he was an artillery specialist and designed many infantry rocket devices. The inventor, in describing his jet engine, said that its use would eliminate the four glider launching devices of the past: automobile towing, winch towing, airplane towing, and shock-cord launching.

The rudder, constructed with laminated paper plastic, was shown in the second exhibit side by side with an identical rudder constructed in fabric and wood, from one of the Baby Bowlus gliders. It was part of an assembly designed by Steven E. Mautner, Vice-President and Chief Engineer of Skydyne, Inc., in conjunction with Nicholas J. Hoff, Associate Professor of Aeronautical Engineering, of the Polytechnic Institute. Skydyne is pioneering a sandwich-construction glider built in separate units similar to a prefabricated house. The units will be put into a "kit" which glider pilots can assemble

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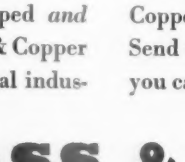

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themselves. The rudder was shown with a number of panels of "sandwich" made of different materials and accompanied by a paper "Sandwich Construction Applied to Gliders," presented by Drs. Hoff and Mautner at the conference.

It is understood that no glider has ever been built with "sandwich" materials. Drs. Hoff and Mautner state that their investigations prove the suitability of sandwich construction to gliding and soaring planes and that, through its use, advantages can be obtained both from the aerodynamic and weight standpoint. It is desirable, they conclude, to build experimental sandwich gliders in order to explore fully the manufacturing and design details. They believe a greater demand for gliders will develop so that "sandwich" planes may soon be manufactured at a cost within reach of the gliding enthusiast.

Dr. Hoff, who delivered the paper, pointed out that the use of an airplane skin of sandwich type, which has paper plastic for the face material and cellulose acetate for the core material, would produce gliders lighter than any existing today. The face of this material measures $^4/_{1,000}$ in. and the core material approximately $^1/_8$ in. It weighs slightly less than the thinnest-gauge plywood, which is manufactured in $^1/_{32}$ in., and its weight is only one-third that of the thinnest aluminum sheeting used for aeronautical purposes. One sq.in. of the material can take 30,000 lbs. of tension. To show comparative weights, Dr. Hoff said that paper plastic "sandwich" weighs 6 lbs. per cu.ft., as against plywood which weighs 34 lbs. per cu.ft., and aluminum alloy which weighs 174 lbs. per cu.ft.

Other papers presented at the conference were as follows: "The Contributions of Gliding and Soaring to Aviation," by Wolfgang Klemperer, of Douglas Aircraft Company, Inc.; "Glider Tactics," by Major Eliot F. Noyes; "Calibration of Barographs," by Victor M. Saudek, of All American Aviation, Inc.; "Glider Pickup," by Arthur B. Schultz, of All American Aviation, Inc.; "Improved Efficiencies in Glider Structures and Operating Costs per Ton/Mile with Cargo Gliders," by I. Bouton, of Laister-Kauffmann Aircraft Corporation; "Glider, Tug Performance Studies," by August Raspet, Technical Editor of *Soaring;* "Value of Glider Background to Airline Flying," by Loren V. Petry, of Transcontinental & Western Air, Inc.; "One Design Class," by Paul Schweizer, of Schweizer Aircraft Corporation; "Why We Used Single Place Glider Training in Europe," by J. Illaszewicz, of Canadian Wooden Aircraft, Ltd.; "Gliding in War Torn Europe," by Alexis Dawydoff, of *Cadet Aeronautics;* "Powered Gliders," by Stanley Corcoran, of Frankfort Sailplanes; "Utility Gliders and Their Design," by W. Czerwinski, of Canadian Wooden Aircraft, Ltd.; "Variable Incidence Wings," by G. W. Cornelius, of Cornelius Aircraft Corporation; "Practical Thoughts on Thermals," by Karl O. Lange, Meteorologist; "Research Problems of the Soaring Society of America," by August Raspet, Technical Editor of *Soaring;* "Instruments and Flight Technique," by Robert F. Blaine, of the Southern California Soaring Association; "Miniature Barograph," by A. L. Lawrence, of Kenyon Instrument Company. Polytechnic Institute of Brooklyn.

Underground Pipe Conduits for Submerged Conditions

For use at airfields in low or moist locations where scattered buildings require central heating, a modified design of underground pipe conduit is intended to provide complete protection against moisture. The standard Therm-O-Tile design is employed, with an internal drain, so that in the event of condensation of moisture out of the air within the conduit, it will all be drained out by means of the drain channel.

In this design there is a wide subbase beneath the standard spread-footing foundation. The subbase is wider for two reasons: (1) to reduce foundation-unit pressure, and (2) primarily to simplify the mechanics of joining the waterproofing membranes so that leakage will be impossible. The standard design is hermetically sealed by surrounding the entire conduit with a membrane waterproofing and then placing it on top of the additional subbase. The waterproof membrane usually consists of 15-lb. asphalt-saturated felts laid in hot asphalt and finished with a top mopping of hot asphalt. Sometimes the wet supporting soil is not sufficiently solid even for this extra-wide subbase, in which event the subbase is made to rest on driven piling. H. W. Porter & Company, Newark, N.J.

Gap-Style Motorized Hydraulic Presses

The Hy-Speed motorized press was created to meet the demand for a popularly priced unit that could be used for production-line work of marking, forming, notching, pressing, broaching, assembling, and other operations. The presses are made in two models, of 10- and 20-ton capacity, with 10 per cent extra tonnage available. A hand-lever hydraulic valve controls the ram movement through the feed, hold, or return positions.

Other features of the press are listed as the hollow, large-area ram for holding punches and other fixtures, the lapped ram, the packless design, and the twin pressure gauges showing pressure and tons.

The stroke of ram is 12 in. The motor-driven hydraulic pump furnishes $1^3/_4$ gal. oil per min. to the ram, giving 1.5 in. per sec. ram speed in the 10-ton, and 0.8 in. per sec. ram speed for the 20-ton unit.

The 10-ton press operates at the rate of four complete strokes per min. and the 20-ton model operates at two strokes. The presses are equipped with 220-volt, 60-cycle, three-phase motors as standard equipment. The motor-drive unit can be purchased separately, equipped with a table top to be used for testing hydraulic equipment or as a hydraulic test bench. It furnishes pressure up to 4,500 lbs. per sq.in. Reimuller Brothers Company, Franklin Park, Ill.

Torque Screw Driver

The Livermont Roto-Torq is a torque screw and bolt driver designed to eliminate danger of over- or undertightening, thread stripping, or damage to material. It may be adjusted to any torque desired between 1 in.-lb. and 25 in.-lbs. for setting screws, small nuts, bolts, etc. Because it disengages itself at the proper torque, it is impossible for the operator to tighten beyond the prescribed fit or tightness.

Models of this tool, according to the manufacturer, have met wide acceptance in the electrical, radio, and plastic fields, particularly for application where self-threading screws have been apt to strip through sheet metal or where small screws become damaged from overtightening.

The mechanism operates on a spring principle and is not to be confused, it is stated, with a clutch, cam, or friction principle. Torque tolerances are very close and the torque is not influenced by excessive oil or other normal foreign material, nor by the way it is held or used by the operator.

The tool is $7^3/_4$ in. long, with a handle of 1.30 in.-diameter. Two models are available. One has a screw driver as an integral part of the shank, and the other has a $^1/_4$-in. square drive. Adjustments may be made from outside the handle by a calibrated vernier arrangement. Richmont, Inc., Los Angeles.

Height Indicator with Electrigage

A new type of precision height indicator with electric gauge is claimed to yield a quick, positive and accurate reading. It is designed for use on a surface plate.

The instrument includes a surface plate block, a 26-in. column with rack, and an Electrigage of 1000–1 amplification, having a smallest graduation of 0.0001 in., with electric pickup head mounted on an adjustable extension arm. A micrometer is provided for $^3/_{32}$-in. vertical adjustment of pickup head, allowing the operator a much wider range of rough comparison measurements than is possible with the Electrigage alone.

The mounting bracket is adjustable vertically over a range of 18 in. The extension arm can be adjusted to bring the pickup head to any location, with a throat capacity, gauging point to edge of column, of $4^1/_2$ in. to 11 in., and gauging point to edge of base, of $3^1/_2$ in. to 10 in. The pickup head can be rotated and locked in position within a full range of 360°, while an adjustment knob facilitates the coarse and fine setting-up. The Sheffield Corporation, Dayton, O.

A LITTLE WOODEN BOX that's speeding aircraft progress

By JOHN B. KENNEDY

Famous news analyst tells how "Suggestions for Victory" from Bell Aircraft employees have saved thousands of dollars of the taxpayer's money and a comparable number of manhours

"IN every Bell Aircraft plant you'll see suggestion boxes. Into these boxes Bell Aircraft employees, who think while their skilled hands are at work, last year deposited 4200 ideas to improve plant operations and Bell Aircraft products. One third of these, after being cleared through Bell Aircraft's Patent Office, have been put to work. As a result thousands of dollars have been saved in the cost of building Bell airplanes and other war weapons. Other suggestions are helping to speed Victory by saving thousands of manhours.

"Take the case of a supervisor of Intra-Plant Traffic in one Bell Aircraft plant. His plan for simplifying the operation of the conveyor system, by which workers receive material and parts, eliminated 54,561 telephone calls per week—totaling a yearly saving of $39,845, to say nothing of time.

"Instead of a telephone operator notifying the station that supplies are on the way, when the conveyor passes a certain point, it lights an electric bulb. This signal notifies the worker to be on the lookout.

"This new system is one of many production methods suggested by Bell Aircraft employees that are now in use in other Allied Aircraft plants.

"Bell Aircraft workers are making every effort to speed the day of Victory. When that time comes, you can trust this same manufacturing skill and ingenuity to bring you many things to make for a better world at peace."

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B-29 Boeing Superfortress

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Gyrosyn Compass

The development of a new flight instrument, the Gyrosyn compass, has been announced. This device is described as a directional gyro synchronized with the magnetic field of the earth.

In the Gyrosyn compass the functions of a directional gyro and a magnetic compass have been combined. The result is reported to be not only greater navigational accuracy but also simplification of the pilot's duties. This is partly because the Gyrosyn compass allows for deadbeat indication and accurate magnetic headings without northerly turning error or the necessity of resetting. The new compass also avoids the effect of disturbances in the earth's magnetic field caused by proximity of electrical apparatus and armor plate.

An electrically driven directional gyro, the compass is controlled by a flux valve. The latter is the "stand in" for a magnetic compass because it detects the direction of the earth's magnetic field. Small, hermetically sealed, and with no rotating parts, the flux valve may be rigidly mounted in a wing tip at a safe distance from the disturbing influences of the cockpit.

The compass is installed on the pilot's instrument panel or at the navigator's station. Up to six repeaters for remote indications may be used with it. The compass with two repeaters weighs less than 12 lbs. Provision is also made for furnishing azimuth stabilization as required by any other equipment.

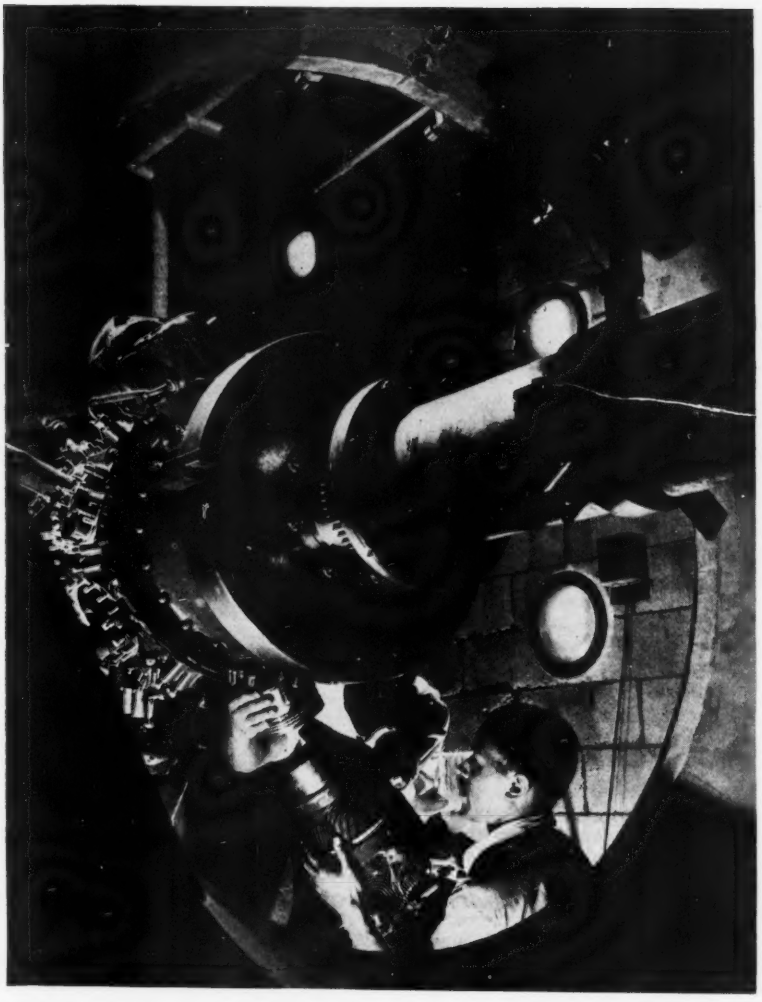
When rough air momentarily swings the flux valve out of the horizontal, the resultant fluctuating signals do not register as error on the indicator. This is attributed to the fact that the directional gyro integrates all short-period disturbances and oscillations while the accurate indication continues. In a prolonged turn, erroneous signals may show in part on the indicator but they disappear without oscillation and without any corrective measures on the part of the pilot as soon as the plane has been returned to straight flight.

Employment of a split-arrow course-setting device facilitates the reading of both the Gyrosyn compass and the repeaters. Sperry Gyroscope Company, Inc.

Propeller Fairing Material

The makers of Cell-Tite, an ebony-like, cellular rubber material from which propeller fairings are made, state that the material has a greater strength-weight ratio than other materials produced commercially for the same purpose.

The material is made in various weights from 8 to 20 lbs. per cu.ft., depending on the use to which it is to be put. The fairings affixed to Hamilton Standard propellers weigh only 4 to 6 lbs. In addition to the attributes of strength, hardness, and light weight, the material has other characteristics making it suitable for wide use in industry. It is stated to have more buoyancy and lower water absorption than cork, as well as good thermal, electrical, and sound-insulation qualities. It can be molded to almost any shape or form. Being practically impervious to water and weather and with high resistance to chemical attack, it has excellent aging properties. It can be sawed, drilled, planed, and otherwise worked much the same as wood. The Sponge Rubber Products Company, Derby, Conn.



Power shaft of an aircraft engine being installed in the latest aviation fuels testing unit, built at Bayway, N.J., by the Standard Oil Company (New Jersey). Horsepower generated by the test engine is absorbed by a dynamometer, while instruments measure performance of fuel and lubricants in the control room adjacent to the test block. The control room itself is isolated from the test cell by a "floating" cork foundation.

Full-Scale Multicylinder Aircraft-Engine Fuel-Test Stand

Stated to be the first of its kind to be operated by the petroleum industry, a full-scale aircraft-engine test stand, designed for research on aviation fuels and lubricants, was put into operation on September 19 at the Esso Laboratories of the Standard Oil Development Company.

The operators of the new test stand anticipate that they will be able to accelerate improvement in the 100-octane gasoline now used by Allied air forces, and possibly increase the production of this fuel. The information obtained from the test stand is expected to result in conservation of raw materials, such as crude oil, for high-octane fuels, since a better guide to decisions on manufacturing will insure the largest volume of fuel of the desired quality from available raw materials.

The test stand as now completed, with its special accessory facilities, is believed to be one of the most efficient for quick and accurate studies, such as:

(1) The testing in actual engines of exploratory fuel blends to evaluate existing processes for making high-octane aviation gasoline components, and more particularly new processes, thus enabling decisions to be made as to desirability for commercial production. It will also permit the evaluation on a relative basis of the components now available for the blending of aviation gasoline. It is of the greatest importance that multicylinder investigations be carried out so that the necessary decisions on manufacturing can be made

The history of aviation proves that *quality spark plugs* assure not only better performance but also greater operating economy, requiring many fewer man-hours in servicing. And in an industry whose life-span is most often measured merely in years, BG AVIATION SPARK PLUGS have demonstrated their outstanding quality *for decades*— since 1917.

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well in advance of the day when volume production is needed, and that such decisions be the correct ones to insure from available raw materials the largest volume of fuel of the desired quality.

(2) Influence of engine-operating variables on fuel performance and antiknock behavior, e.g., effect of speed, spark advance, mixture ratio and automatic ratio control, temperature, compression ratio, and pressure as influenced by supercharger gear ratio, etc.

(3) Antiknock requirements of engines operating under combinations of the above variables, and particularly those combinations found to exist in practice. Present knowledge on this score is inadequate.

(4) Fuel-to-cylinder distribution pattern of engines operating under combinations of above variables, when using fuels of different volatility characteristics.

(5) Closely allied with the preceding study would be one about the influence of distribution on the behavior of fuels having their antiknock quality controlled within the distillation range and thereby permit of setting a specification to insure optimum performance over a wide range of conditions.

The main structure includes the test cell with its intake and exhaust stacks, the control room, the equipment room, the service room, and on mezzanine floors two fan rooms, an air filter chamber, and a weigh-scale room. The test cell, stacks, and fan rooms are of heavy reinforced concrete construction with walls from 12 in. to 16 in. thick. Other portions of the structure are built with brick walls, wood rafters, and gypsum roofing. The test cell itself is 77 ft. long by 18 ft. wide with a clear height of 20 ft.

In order to reduce or damp the vibrations from the engine, the entire rotating assembly, consisting of the test engine, stub shaft and dynamometer, is mounted on a block of concrete weighing 240 tons, which is in turn doweled directly to the pile cap forming the foundation for the whole building. The instruments in the control room have been isolated from the rest of the structure by building the control-room floor as a separate unit, free from the walls on all sides, supported on blocks of cork designed to absorb the remaining vibration which would otherwise be transmitted through the foundation.

The laboratory is equipped with facilities for loading the test engine, together with means for controlling, measuring, and dissipating the power developed. It also has facilities for supplying, controlling, and measuring fuel, lubricating oil, combustion air, and cooling medium; and provisions for the necessary fire protection and safety features. When fuels are to be tested in modern multicylinder aircraft engines, the equipment requirements enter a range of sizes far in excess of those normally considered in the laboratory class. In the test stand, 100 hp. is needed to supply combustion air to the engine carburetor, 400 hp. is consumed in furnishing cooling air, and a total of some 1,100 hp. in electric motors is required for operation of the test stand.

The test stand is designed to handle either liquid- or air-cooled engines and to test pusher as well as tractor power plants. The engine to be used in the tests is rigidly mounted close to the cooling air duct on a tubular steel ring mount simulating the mount provided on a plane. The ring mount is supported by a heavy cast-steel stand secured by tee bolts to a massive cast-iron bed plate.

The absorption unit will absorb 2,000 hp. over a 1,200 to 2,500 r.p.m. speed range. Below 1,200 r.p.m. the absorption decreases with speed. The driving dynamometer has a driving capacity of 500 hp. at 1,750 r.p.m. and has a speed range of 0 to 1,750 r.p.m. Because of the characteristics of the magnetic coupling, the power available varies directly with the speed of the engine. The ratio of the test-engine nose gears will be selected to keep propeller-shaft speeds below 1,750 r.p.m. where complete testing is required. By using the magnetic coupling of the driving unit as an auxiliary absorption dynamometer 2,500 hp. may be absorbed over the 1,200–2,500 r.p.m. speed range. The dynamometer is operated in this manner by locking the induction motor half of the magnetic coupling to the frame of the driving dynamometer and energizing the coupling's field windings. This rating is based on cooling water at 100°F. With the lower water temperatures that are normally available, tests can be carried up to at least 2,800 hp.

In order to meet the exacting standards of research work the dynamometer is electronically controlled. The absorption and the driving dynamometer fields are excited by individual grid-controlled rectifiers of the Thyratron type. Precise speed control is obtained by using the amplified output voltage of a tachometer generator driven by the dynamometer to bias the grids of the rectifier tubes. With this type of control, speed is held very closely from no load to full load, and it permits rapid transfers from absorption to driving with no change in speed. This feature is quite important for accurate test results, since as soon as the ignition is cut for a driving test, the engine begins to cool. Therefore, measurements must be made before temperature changes have a chance to affect engine friction.

Remote indication of the dynamometer-scale reading is obtained by means of an optical system. A projector unit at the scale projects an image of the scale dial. The beam of light in its 20 ft. of travel goes through four layers of window glass to enter the control room, then makes two 90° turns by means of mirrors, and finally ends up on a ground-glass viewing screen on the instrument panel. The scale dial has a 2,000-lb. range graduated in 2-lb. intervals, and three 2,000-lb. drop weights, making a total capacity of 8,000 lbs. The drop weights are motorized and weights are added or removed by operating a selector switch on the panel board.

An intricate system of lines, valves, weigh tanks, and automatic, interlocking controls handles the supplying of accurate amounts of fuel and oil to the test engine. In addition to the operation of the engine for fuel tests, aviation lubricants will also be tested. Standard Oil Company of New Jersey.

Reflex Torquing

The Sturtevant sensory torque wrench resembles the familiar torque wrench in appearance, but differs from it in this respect: whereas the usual instrument depends solely on visual reading to determine the applied torque, the sensory model embodies two other features, "sound" and "feel."

These sensory features work as follows: A trigger finger that can be set at any desired signalling point is provided. As torque is applied with the wrench, and at the exact instant the "set" torque is reached, the sensory action (1) sounds a loud and distinct click, and (2) imparts a definite strong impulse to the hand. Thus, through three senses, sight, sound, and touch, the operator automatically releases (by reflex action) his pull on the wrench, making torque both fast and accurate. P. A. Sturtevant Company, Addison, Ill.

"ST" Synthetic Rubber

Extreme low-temperature flexibility without the addition of plasticizers, as well as excellent resistance to solvents, ozone, and sunlight, are characteristics claimed for Thiokol "ST," a new type of synthetic rubber. It was developed as a solution for many production problems heretofore unsolved by either natural rubber or synthetics.

The new "ST" compound was among the first of the polysulphide synthetics designed to overcome "cold flow" difficulties, having a marked resistance to the tendency to take on a permanent deformation under pressure or stress. The odor commonly associated with these polysulphides has been reduced to such a negligible factor in the "ST" blend that it is expected to add considerably to the new polymer's workability and versatility.

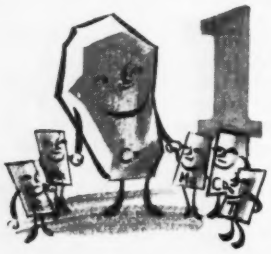
The makers state that the new rubber's workability within a wide range of temperatures, without the addition of plasticizers that are readily extracted by aviation gasoline and hydraulic brake fluid, and its low volume swell in hydrocarbon fuels, make it particularly useful in the aviation and automotive industries for sealants, cements, and acid-resistant coatings. Thiokol Corporation, Trenton, N. J.

Double-Row Needle Bearing for Aircraft Pulleys

The double-row PN needle bearing, which is stated to have a friction coefficient as low as that of any other type of antifriction bearing, has been specially designed to minimize friction in aircraft-pulley applications. Conforming to the requirements of specifi-

Basic Facts about STAINLESS STEELS

A STAINLESS STEEL PRIMER



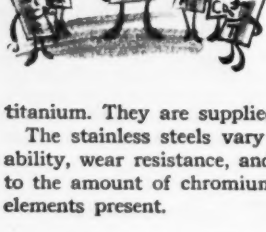
STAINLESS STEELS are corrosion-resistant steels containing at least 12 per cent chromium with or without other alloying elements, such as nickel, manganese, molybdenum, columbium or titanium. They are supplied in a wide range of analyses.

The stainless steels vary in corrosion resistance, workability, wear resistance, and physical properties according to the amount of chromium, carbon and other modifying elements present.

VALUABLE PROPERTIES INCLUDE:

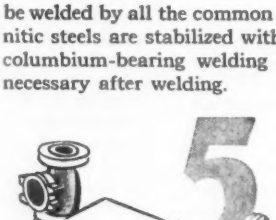
Good corrosion and oxidation resistance . . . varying almost in direct proportion to the amount of chromium present.

High strength-weight ratio in some cold-rolled types permitting fabrication of strong, light-weight trains, aircraft, and other structures.

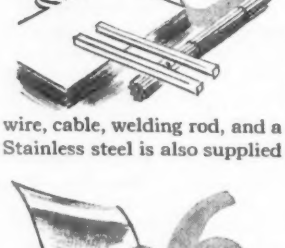


MAINTENANCE of stainless steels is simple. Washing with soap, water, and a cleanser recommended for stainless steel will keep the surface bright and free from surface deposits.

FABRICATION is accomplished by almost all common methods. They can be machined, spun, deep-drawn, forged, punched, stamped, and otherwise mechanically-worked. They can be welded by all the common welding methods. If the austenitic steels are stabilized with columbium or titanium, and columbium-bearing welding rod is used, no annealing is necessary after welding.



MANY FORMS are available in the common analyses including sheet, plate, strip, tubing — both seamless and welded — bars, wire, cable, welding rod, and a variety of cold-rolled shapes. Stainless steel is also supplied as foundry castings.



APPLICATIONS of stainless steel are numerous. Because of their resistance to corrosion and oxidation, as well as their high strength and bright surface, stainless steels have been used in hospitals, chemical plants, oil refineries, railroad trains, aviation equipment, and power plants. In the present emergency, they are available only for those industries participating in war production.

• • •

Although we do not make steel, we have for more than 38 years produced "Electromet" ferro-alloys and metals used in making steel. With the knowledge accumulated from this experience, we are in a position to give impartial advice. If you have a specific problem concerning the manufacture, fabrication, or use of stainless or other alloy steels, consult us without obligation.

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In Canada, Electro Metallurgical Company of Canada, Limited, Welland, Ontario.

cation AN-FF-P-796, this recent addition to the manufacturer's line of needle bearings offers several features particularly intended for aircraft-pulley use.

Small-diameter needle rollers, characteristic of all Torrington needle bearings, provide adequate capacity to meet all standard Government and individual aircraft company requirements, and the small outside diameter of the bearing contributes to important weight-saving features in the design of antifriction aircraft pulleys.

Efficient lubrication is obtained by its enclosed design, which provides ample space for retention of the lubricant, without danger of excess grease being present. The Torrington Company, Torrington, Conn.

Machine for Washing Oil-Temperature Regulators

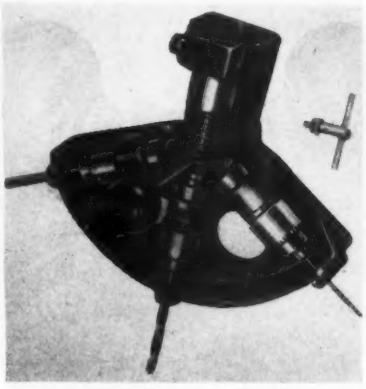
With the automatic Turco Surj Washer for cleaning aircraft oil-temperature regulators, many regulators removed after engine failure and discarded may be reclaimed for continued service. To illustrate the thoroughness of cleaning, the maker states that a quantity of metal particles and other grit has been removed by the washer from an aircraft oil regulator that had previously been cleaned by conventional methods.

Seven different cleaning operations are performed in sequence by the turning of valves conveniently positioned in a panel on the front of the washer. As the various solutions are put through it, the regulator is revolved by the cradle with abrupt changes of speed, which set up a positive surging action.

The first operation is precleaning with hot water and air to remove excess engine oil. Then Turco Surjex, an oil-emulsifying compound and carbon-dissolving agent developed for this particular purpose, frees the regulator of wax, carbon, sludge, metal particles, and other impurities. This is followed by a hot-water rinse. A solution wash then removes the oxides and tarnish and produces the bright surfaces necessary for maximum heat transfer or for soldering, if soldering is necessary.

A cool-water rinse, followed by one of hot water, then flushes out all traces of the solution. Finally, air is circulated through the regulator to dry it, after which it is ready for oven drying, repair, preparation for storage, or return to service.

As there are two cleaning compartments in the washer, individually controlled, several regulators can be cleaned on one side while a particularly dirty one, requiring prolonged cleaning, can be handled on the other cradle. A metal cabinet, 8 ft. long, 3 ft. deep, 62 in. high, houses the entire unit. Cradles, temperature and pressure indicators, and valve controls are within full view of the operator. All working parts are readily accessible. Turco Products, Inc., Los Angeles.



Universal Engineering Company's drill press turret head.

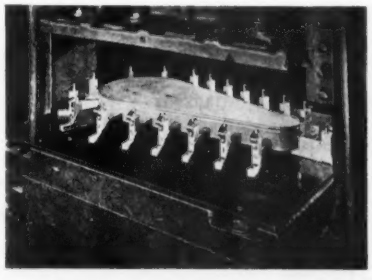
Water-Soluble Paint Stripper

Turco Stripper L-780 is offered as an efficient, water-soluble paint stripper that loosens paint for speedy removal with water. According to the manufacturer, the hosing off of an application of this stripper leaves a clean, paint-free, water-break free surface requiring very little aftertreatment to prepare it for further processing.

The new material is claimed to be noncorrosive on metals, making it suitable for use on aircraft parts or assemblies and for the removal of zinc-chromate primer, as well as other paint coatings. It is said to be safe for use on wood, with no tendency to cause warping, and to conform with Navy specification C-113 for noninflammability of paint strippers.

It has a slow rate of evaporation, making one coating usually sufficient to complete the stripping job. Surfaces that are oily or covered with road film need no precleaning before applying the stripper.

Applied with brush or spray, the material is left on the surface for a period ranging from 5 to 20 min. Loosened paint is scrubbed with a water-saturated brush and is then removed by hosing with water, steam, or an air-and-water gun. Turco Products, Inc., Los Angeles.



A type "H" Wales Strippit Corporation horizontal hole-punching unit set up with the work nested in position ready to be punched around the entire rim. Note that nothing is attached to the press ram.

Drill-Press Turret Head

A new three-position turret clamps on the quill of any standard drill press and gives the operator a choice of three different sized drills or other tools. This permits continuous operation without loss of time in moving work from one drill press to another.

To attach the new multiple tool holder, the operator simply removes the drill chuck and depth gauge and slips the bracket over the quill. All parts are interchangeable. Its capacity is $^1/_4$-in. drill size, and Jacobs $^1/_4$-in. capacity chucks are furnished as standard equipment.

The turret is so constructed as to provide sufficient clearance for most types of jigs and fixtures and is easily shifted from one position to the other by a light movement of the indexing lever. Positive indexing locations are provided. Universal Engineering Company, San Diego, Calif.

Adjustable Work Table

The Rightop work table is adjustable to numerous positions. It raises and tilts, besides having interchangeable tops. With the holding rack, the table makes it possible to keep as many as twelve jobs on the board at one time.

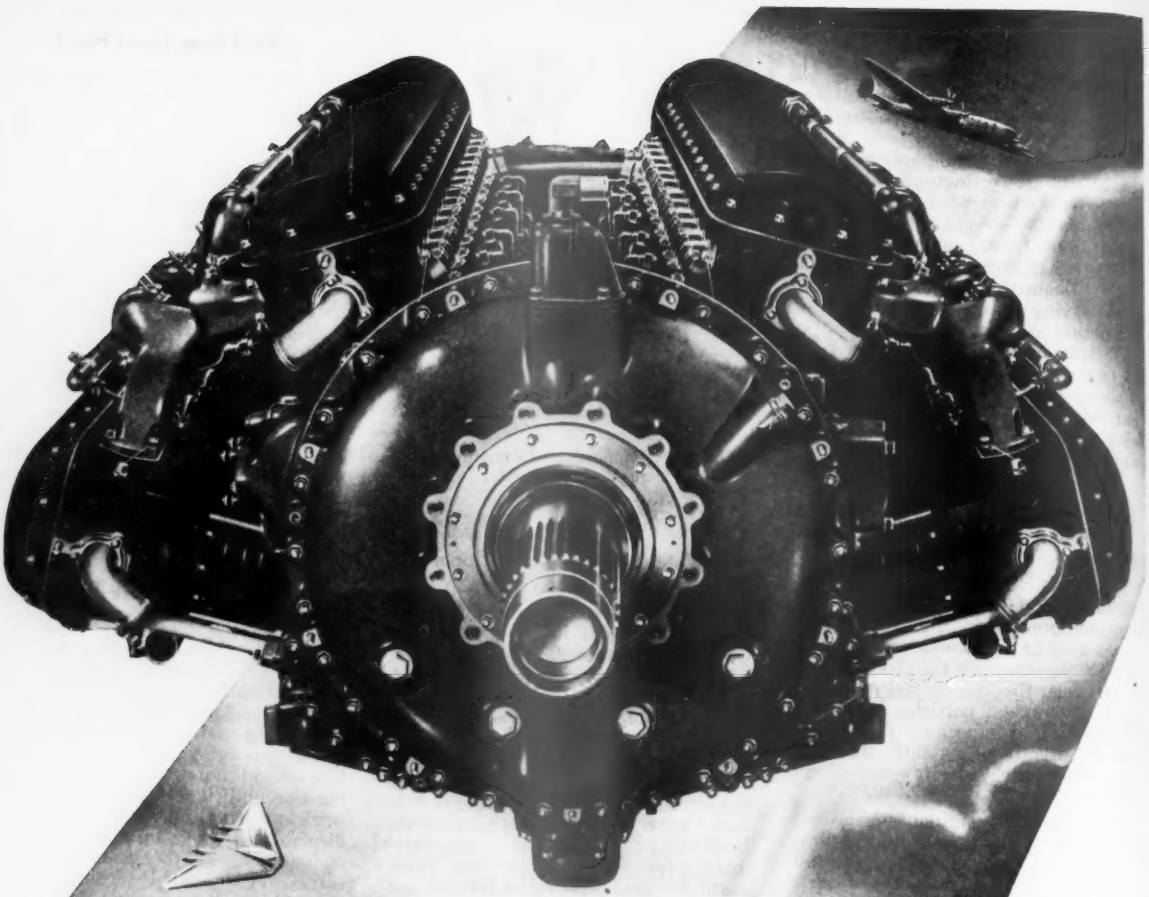
The top being removable, it simply lifts off and slides into the rack where it remains until it is needed again. The work in progress on the top need not be displaced. By interchanging tops, work on one job and then another can be carried on without disturbing any one job. Twelve tops having areas to suit give the equivalent of a dozen work tables for any one operator.

Adjustable as to height by simply turning the crank, the table is always at the right height for the operator, sitting or standing. By tipping the top the operator obtains any angle desired. Voss Machinery Company, Pittsburgh.

Horizontal Hole-Punching Units

Announcement of a new hole-punching technique with horizontal Type "H" hole-punching units has been made. These units are designed for punching holes in flanges, angles, container sides, and similar shaped and formed work. Punching holes in the sides of the work instead of on top of flat surfaces was made possible by designing this unit so that the punch moves back and forth horizontally instead of vertically. "H" Units eliminate single-purpose cam-action dies.

Each unit is independent and self-contained, permitting the same group of units to be reused indefinitely for different operations. The minimum center to center distance is $^7/_8$ in. Punch, die, guide, and stripper spring are held as an integral unit by the holder. This holder feature keeps the punch and die in perfect alignment. It also reduces press "down time" to a minimum, by permitting the patterns to be set up outside the press. Wales-Strippit Corporation, North Tonawanda, N.Y.



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Institute News

The John Jeffries Award for 1944

The John Jeffries Award, which is given annually by the Institute of the Aeronautical Sciences for notable contributions to Aero Medical research, has been awarded for 1944 to Air Marshal Sir Harold E. Whittingham, Director-General of Medical Services of the Royal Air Force.

Sir Harold has had 27 years' continuous service with the Royal Air Force Medical Branch, chiefly in appointments directly connected with aviation medicine and research. He is a Fellow of the Royal College of Physicians and Surgeons of Glasgow, Edinburgh, and London. He is an LL.D. of Glasgow University and has been Honorary Physician to the King since 1938. He was created a Knight of the British Empire in 1941.

He was graduated from Glasgow University and saw service in the last war in Iraq and India. In 1934 he initiated and organized all Aviation Medicine Research of the Royal Air Force. His research work covers almost the entire aero medical field.

The Award will be presented to him at the Honors Night Dinner of the Institute in January. The members of the Committee who select the recipient of the Award are: Director of Research, National Advisory Committee for Aeronautics; President, National Aeronautic Association; President, Air Transport Association; President, Aero Medical Association; President, Institute of the Aeronautical Sciences; President, Aeronautical Archives.

The previous recipients of the Award were: 1940, Dr. Louis H. Bauer, Chief Cardiologist, Meadowbrook Hospital, Hempstead; 1941, Major Harry G. Armstrong, U.S. Army Medical Corps, School of Aviation Medicine; 1942, Dr. Edward C. Schneider, Professor of Biology, Wesleyan University; 1943, Brig. Gen. Eugen G. Reinartz, Commandant, Army Air Forces School of Aviation Medicine.

Fall Meeting

Plans have now been completed for the Fall Meeting of the Institute, which will be held in the Engineers' Club of Dayton, Dayton, Ohio, on November 9 and 10, 1944.

The sessions will be held during the afternoons and evenings of the 2 days. The Chairmen of the four sessions will be: Bradley Jones, Professor in Charge of the Department of Aeronautical Engineering, University of Cincinnati;

Air Marshal Sir Harold E. Whittingham.

Charles S. J. MacNeil, Jr., Chief Engineer, Aero Products Division, General Motors Corporation; Richard M. Mock, Vice-President, Lear, Inc.; and John R. Weske, Professor of Aerodynamics, Case School of Applied Science.

The following papers have been accepted for presentation at the meeting:

Air-Borne Electric Computing Gun Sight—R. H. Bailey, Fairchild Camera & Instrument Corp.

Electrical Flight Control—Major W. A. Barden, Wright Field.

Electrical Control Circuits for Aircraft—Capt. J. E. Harrell, Wright Field.

Electrical Retraction Systems—H. J. Finison, Wright Field.

Electrical Equipment for Aircraft—Lt. Col. T. B. Holliday, Wright Field.

The Radio Navigator—Dr. S. B. Littauer, Bendix Radio Division, Bendix Aviation Corp.

Radio Telemetering—David William Moore, Jr., Engineer, Fairchild Camera & Instrument Corp.

Potentialities of a Capacitance Measurement Method for Fuel Quantity Gauges in Aircraft—D. B. Pearson and C. F. Savage, General Electric Company.

Operational Methods in Servo-Mechanism Design—W. E. Restemeyer, University of Cincinnati.

Aircraft Engines Gage Unit—C. H. Ridgley and J. L. Theisen, General Electric Company.

Radio Noise in Aircraft Engines—Captain A. E. Teachman, Wright Field.

Design Considerations and Development of Electro-Hydraulic Systems. W. C. Trautman, Chief Engineer, Pacific Division, Bendix Aviation Corp.

A final program, which will be mailed to all members when ready, will give the times of each session and an abstract of the papers in each session.

All members planning to attend this meeting are urged to make their hotel and transportation reservations as far in advance as possible.

Third Visit to Air Technical Service Command

The third group of members of the Institute to visit Wright Field were the guests of Lt. Gen. William S. Knudsen and the officers of his Command on September 8 and 9.

These groups had to be limited to 75 because of local transportation problems. Professors at aeronautical schools were given priority for this visit. Twenty-two educators came from California, Minnesota, Texas, Georgia, Massachusetts, and other states and cities.

After visiting the interesting repair, maintenance, and supply divisions at Wright Field No. 1 (formerly Patterson Field), the group dined together on the Terrace at the officers' Club. In the evening Major Lester D. Gardner, Chairman of the Council of the Institute, introduced each of the professors. John K. Northrop, Charles H. Colvin, and Albert E. Lombard expressed their appreciation to the Command for the courtesy extended to the Institute in giving members the privilege of seeing the many activities of the Air Technical Service Command.

Major Gen. Clements McMullen, Chief of the Maintenance Division, described the operations of his section and showed the methods of maintenance and of controlling the flow of supplies to the Air Forces.

On Saturday, following a review of the engineering program of the Air Forces by Brig. Gen. Franklin O. Carroll, the group visited the new wind tunnels, Power Plant Laboratory, Equipment Laboratory, Aero Medical Laboratory, Propeller Laboratory, and Armament Laboratory and inspected the Flight Section.

Demonstration flights were made of new types of airplanes, and representative types of U.S., British, and captured enemy aircraft were exhibited.

These visits were authorized by Gen. H. H. Arnold, who, in a telegram, said: "The advantages of these meetings between engineering groups and the Army Air Forces cannot be stressed too highly. Such close cooperation has

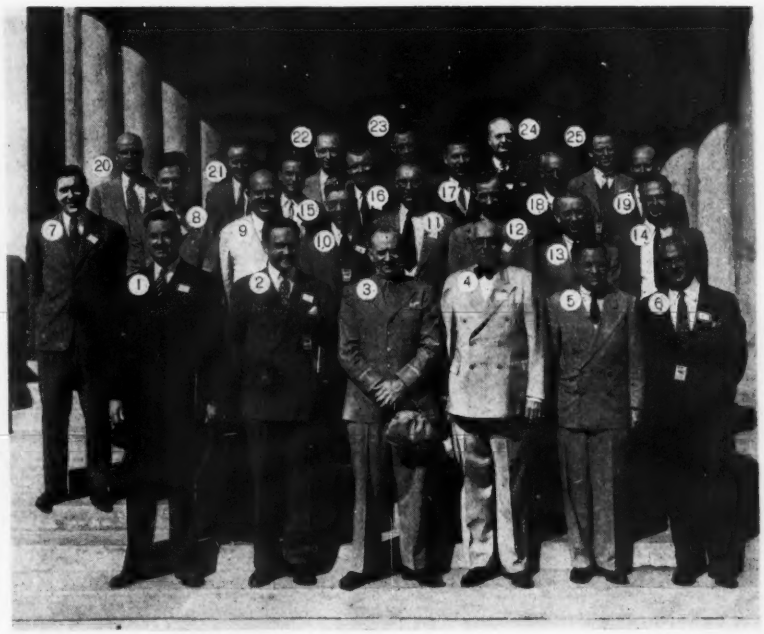
Members of the Institute and officers of the Air Technical Service Command before the tour of Wright Field and nearby Patterson Field on September 8. (1) Capt. R. L. Winters, (2) Bennett H. Horchler, (3) Wladimir A. Reichel, (4) John K. Northrop, (5) Lt. Col. G. R. Johnston, (6) E. T. Price, (7) Major Gen. C. McMullen, (8) Lester D. Gardner, (9) Charles H. Colvin, (10) Lt. Col. H. M. Paynter, (11) Capt. J. J. Ducas, (12) W. C. Bonn, (13) Lt. Norton Goodwin, (14) Donald S. Bixler, (15) B. H. Jones, (16) Carl Eugene Davis, (17) W. A. Mechesney, (18) P. W. Brown, (19) Fred M. Young, (20) Daniel C. Sayre, (21) Walter B. Clifford, (22) Reginald M. Cleveland, (23) William S. Hough, (24) Anson Hayes, (25) Joseph S. Newell, (26) Arthur A. Locke, (27) Charles W. Morris, (28) Elmer F. Bruhn, (29) Frederick K. Teichmann, (30) Karl D. Wood, (31) Lt. E. F. Earley, (32) Lt. Norman S. Gilbert, (33) Lewis M. Churbuck, (34) Donnell W. Dutton, (35) L. P. Sharples, (36) Arthur T. Murray, (37) J. T. Mascuch, (38) Jacque Houser, (39) J. L. Reynolds, (40) Elmer L. Sutherland, (41) John D. Akerman, (42) Otto E. Kirchner, (43) Harold R. Talbot, (44) Wilbur C. Nelson, (45) Richard W. Luce, (46) E. M. Lester, (47) John R. Weske, (48) James M. Clark, (49) Capt. J. A. Lumpkin, (50) Lt. D. P. Ryan, (51) Lt. F. E. Bishop, (52) Lt. Pat Austin, (53) Lt. Laura Lou Houghton, (54) Lee D. Warrender, (55) Frederick H. Roever, (56) W. J. Blanchard, (57) Kenith G. Strunk, (58) Robert M. Pinkerton, (59) Shatswell Ober, (60) Marvin Whitlock, (61) O. C. Koppen, (62) George A. Sands, (63) Andrew F. Haiduck, (64) B. F. Raynes, (65) F. E. McCreery, Jr., (66) Robert R. Dexter, (67) F. N. M. Brown, (68) Lt. L. E. Schaefer, (69) R. F. Gagg, (70) W. Wallace Kellett, (71) Kenneth S. M. Davidson, (72) E. W. Krueger, (73) Paul E. Hemke, (74) Albert E. Lombard, Jr., (75) W. W. Cowgill, (76) Elliott G. Rei (77) Darwin L. Holbrook, (78) C. C. Furnas, (79) E. W. "Pop" Cleveland, (80) John F. Kidde, (81) F. P. Callahan, and (82) R. G. Standerwick.

greatly benefited the prosecution of the war."

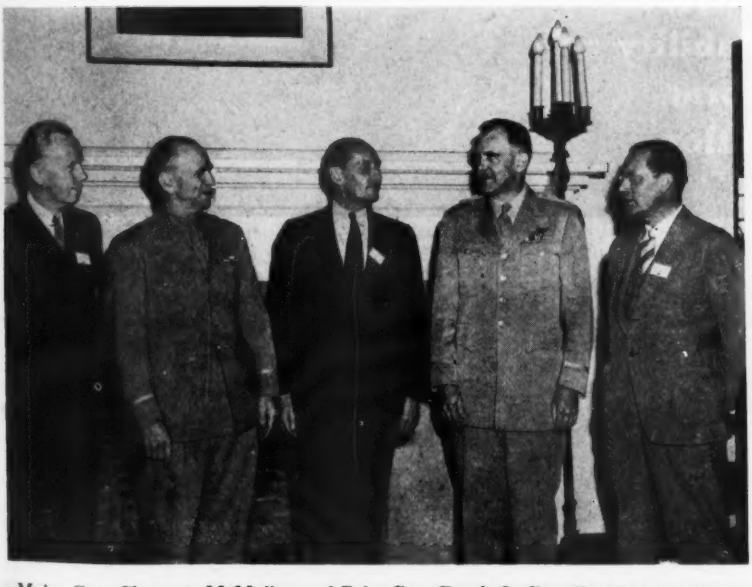
Brig. Gen. P. W. Timberlake, Deputy Chief of Air Staff, wrote: "I have examined with interest the names of the men whom you have selected and agree with you that a better understanding between the Army Air Forces and industry results from such visits. We of the Army Air Forces are keenly aware of the outstanding contribution that industry and its leaders have made towards the accomplishment of our responsibility. We hope never to overlook any opportunity to bring about an even closer cooperation between engineering groups and ourselves now, and in the postwar period. Accordingly, I wish to compliment you on your program and trust that your group will enjoy its visit as much as we welcome the opportunity of acting as your host."

The visits were organized by Lt. Col. G. R. Johnston and Lt. Col. Henry M. Paynter. Major Mitchell, Captain Ducas, and Captain Winters were in direct charge of the party. The Institute is greatly indebted to all the officers who assisted in making the three visits so interesting and helpful to the engineers who found it possible to attend.

The third group included: John D. Akerman, Professor and Head of Department of Aeronautical Engineering, University of Minnesota; Donald S. Bixler, Assistant Manager in Charge of Aviation Sales, Sinclair Refining Company; W. J. Blanchard, General Manager, Aeroproducts Division, General Motors Corporation; W. C. Bonn, Sales Manager, Kollsman Instrument Division of Square D Company; F. N. M. Brown, Professor of Aeronautical Engineering and Department Head, University of Notre Dame; P. W. Brown, Director of Manufacturing, Wright Aeronautical Corporation, Division of Curtiss-Wright Corporation; Elmer F. Bruhn, Professor of Aeronautical Engineering, Purdue University; F. P. Callahan, Commercial General Division, General Electric Company; Lewis M. Churbuck, President, Aeronautical University, Inc.; James M. Clark, Assistant General Manager, Manufacturers Aircraft Association, Inc.; E. W. "Pop" Cleveland, Sales Manager, Strut Division, The Cleveland Pneumatic Tool Company; Reginald M. Cleveland; Walter B. Clifford, President and Treasurer, Clifford Manufacturing Company; Charles H. Colvin, Consulting Engineer; W. W. Cowgill, Director, War Products Division, United States Rubber Company; Kenneth S. M. Davidson, Professor and Director of Experimental Towing Tank, Stevens Institute of Technology; Carl Eugene Davis, General Manager—Manufacturing, Shell Oil Company, Inc.; Robert R, Dexter, Secretary, Institute of the Aeronautical Sciences; Donnell W. Dutton, Professor and Head of Aeronautical Engineering Department, Georgia School of Technology; A. P. Fontaine, Assistant Director of Engineering, Consolidated Vultee Aircraft Corporation; C. C. Furnas, Director of Research, Airplane Division, Curtiss-Wright Corporation; R. F. Gagg, Assistant to General Manager, Wright Aeronautical Corporation, Division of Curtiss-Wright Corporation; Lester D. Gardner, President, Aeronautical Archives, Institute of the Aeronautical Sciences; Andrew F. Haiduck, Vice-President—Engineering, Bellanca Aircraft Corporation; Anson Hayes, Director, Research Laboratories, The American Rolling Mill Company; Paul E. Hemke, Professor and Head of Department of Aero-



Representatives of leading colleges and universities of the United States with Major Gen. Clements McMullen and Lester D. Gardner. (1) Lewis M. Churbuck, (2) Albert E. Lombard, Jr., (3) Major Gen. C. McMullen, (4) Lester D. Gardner, (5) Charles H. Colvin, (6) Arthur A. Locke, (7) Jacque Houser, (8) Robert M. Pinkerton, (9) Daniel C. Sayre, (10) Joseph S. Newell, (11) Shatswell Ober, (12) John D. Akerman, (13) Elliott G. Reid, (14) Frederick K. Teichmann, (15) Kenneth S. M. Davidson, (16) Wilbur C. Nelson, (17) John R. Weske, (18) F. N. M. Brown, (19) Karl D. Wood, (20) Frederick H. Roever, (21) Lee D. Warrender, (22) O. C. Koppen, (23) Paul E. Hemke, (24) Elmer F. Bruhn, (25) Donnell W. Dutton.



Major Gen. Clements McMullen and Brig. Gen. Frank O. Carroll with John K. Northrop (*left*), W. Wallace Kellett (*center*), and E. T. Price (*right*) during the visit to the Air Technical Service Command.

(60) Marvin Whitlock, (61) O. C. Koppen, (62) George A. Sands, (63) Andrew F. Haiduck, (64) B. F. Raynes, (65) F. E. McCreery, Jr., (66) Robert R. Dexter, (67) F. N. M. Brown, (68) Lt. L. E. Schaefer, (69) R. F. Gagg, (70) W. Wallace Kellett, (71) Kenneth S. M. Davidson, (72) E. W. Krueger, (73) Paul E. Hemke, (74) Albert E. Lombard, Jr., (75) W. W. Cowgill, (76) Elliott G. Reid (77) Darwin L. Holbrook, (78) C. C. Furnas, (79) E. W. "Pop" Cleveland, (80) John F. Kidde, (81) F. P. Callahan, and (82) R. G. Standerwick.

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nautical Engineering, Rensselaer Polytechnic Institute; Darwin L. Holbrook, Manager, Aircraft Division, The Fafnir Bearing Company; Bennett H. Horchler, Executive Vice-President, Institute of the Aeronautical Sciences; William S. Hough, Manager, Aircraft Section, Johns-Manville Sales Corporation; Jacque Houser, Instructor, Department of Aeronautical Engineering, University of Michigan; B. H. Jones, General Sales Manager, The National Screw & Manufacturing Company; Bradley Jones, Professor, Aeronautical Engineering, University of Cincinnati; W. Wallace Kellett, President, Kellett Aircraft Corporation; John F. Kidde, President, Walter Kidde & Company, Inc.; Charles N. Kimball, Vice-President in Charge of Engineering, Electronics Division, Aircraft Accessories Corporation; Otto E. Kirchner, Director of Aircraft Engineering, American Airlines, Inc.; O. C. Koppen, Professor of Aeronautics, Massachusetts Institute of Technology; E. W. Krueger, Manager—Automotive Aircraft Division, The Cleveland Pneumatic Tool Company; E. M. Lester, Assistant General Manager, Ranger Aircraft Engines Division, Fairchild Engine & Airplane Corporation; Arthur A. Locke, Associate Professor, Head of Aeronautical Engineering Department, Wayne University; Albert E. Lombard, Jr., Special Assistant to Director, Aircraft Resources Control Office, Aircraft Production Board; Richard W. Luce, Vice-President and Chief Engineer, Boots Aircraft Nut Corporation; J. T. Mascuch, President, Breeze Corporations, Inc.; F. E. McCreery, Jr., Chief Engineer, Rohr Aircraft Corporation; W. A. Mechesney, Manager, Aviation Section, Westinghouse Electric & Manufacturing Company; Charles W. Morris, Chief Project Engineer, AiResearch Manufacturing Company; Arthur T. Murray, Vice-President, Moore Drop Forging Co.; Wilbur C. Nelson, Professor and Head, Department of Aeronautical Engineering, Iowa State College; Joseph S. Newell, Professor of Aeronautical Structural Engineering, Massachusetts Institute of Technology; John K. Northrop, President, Northrop Aircraft, Inc.; Shatswell Ober, Associate Professor of Aeronautical Engineering, Massachusetts Institute of Technology; Robert M. Pinkerton, Acting Head, Department of Aeronautical Engineering, Agricultural & Mechanical College of Texas; E. T. Price, President & General Manager, Solar Aircraft Company; B. F. Raynes, Chief Inspector, Rohr Aircraft Corporation; Wladimir A. Reichel, Director of Engineering, Eclipse-Pioneer Division, Bendix Aviation Corporation; Elliott G. Reid, Professor of Aerodynamics, Stanford University; J. L. Reynolds, Assistant to Director of Engineering, Eclipse-Pioneer Division, Bendix Aviation Corporation; Frederick H. Roever, Superintendent of Instruction, Parks Air College; George A. Sands, Metallurgical Engineer, Electro Metallurgical Company, Unit of Union Carbide & Carbon Corporation; Daniel C. Sayre, Professor and Chairman, Department of Aeronautical Engineering, Princeton University; L. P. Sharples, Vice-President, The Sharples Corporation; R. G. Standerwick, Engineer in Charge, Supercharger Engineering Division, General Electric Company; Kenith G. Strunk, Chief Engineer, Breeze Corporations, Inc.; Elmer L. Sutherland, Executive Vice-President, Aeronca Aircraft Corporation; Harold R. Talbot, Executive Vice-President and Treasurer, Kenyon Instrument Company, Inc.; Frederick K. Teichmann, Professor of Aeronautical Engineering and Chairman, Department of Aeronautics, New York University; Lee D. Warrender, Vice-President, Academy of Aeronautics; John R. Weske, Professor of Aerodynamics, Case School of Applied Science; Marvin Whitlock, Chief Aircraft Engineer, American Airlines, Inc.; Karl D. Wood, Professor in Charge of Aeronautical Engineering, University of Colorado; Fred M. Young, President and General Manager, Young Radiator Company.

Paper Limitations and Publications of the Institute

Appeal to Members

The paper cutbacks made in 1943 have enabled the Institute to provide service for all present and new members in 1944. However, the Institute is now reaching a position where its entire paper quota is being used for present service with no reserve for new members.

In October, all members will be billed for their membership dues for the fiscal year commencing October 1 and for their subscriptions to the magazines. The present supply of paper must be used to render maximum service to all members. The Officers and Council therefore request that where members have the publications available in their company libraries or from other sources that these members discontinue their subscriptions until paper again becomes available. The cooperation of all members will be greatly appreciated.

Conservation Measures

In March, 1943, the War Production Board limited the amount of paper available for printing the JOURNAL OF THE AERONAUTICAL SCIENCES and the AERONAUTICAL ENGINEERING REVIEW. In order to comply with the limitation order, the weight of paper used in the magazines and the trim sizes of both magazines were reduced.

The continued growth in the membership of the Institute necessitated additional conservation measures. The list below summarizes steps taken in July, 1943, to assure service to all present members and new incoming members.

1. The AERONAUTICAL ENGINEERING REVIEW stabilized the amount of pages and established a maximum average number of pages of advertising that would be carried in each year.

2. The JOURNAL OF THE AERONAUTICAL SCIENCES changed its frequency of publication from monthly to quarterly. This was caused by two factors: (A) An actual shortage of material for publication in the JOURNAL and (B) The possibility of saving the printing of eight sets of covers and eight sets of seven standing pages during each year—an appreciable quantity of paper. This change was accomplished without penalizing members, since the quarterly issues were so planned as to contain approximately three times the amount of text normally printed in the monthly issues.

3. Complimentary subscriptions to both the JOURNAL and REVIEW were canceled.

4. Corporate Membership subscriptions to both magazines were reduced.

5. It was decided that no new subscriptions would be accepted from subscribers other than members of the Institute. To date it has been necessary to refuse approximately 750 subscriptions.

Subscriptions to Members

To reduce further the use of paper, a new membership plan was put into effect in October, the time of the yearly billing for dues. By this plan members need not, but may, subscribe to either or both publications at half rate independently of membership dues.

In January, 1944, a further 10 per cent reduction was made effective. It was only through the savings accumulated during 1943 that the Institute has been able to serve its members during 1944.

Prospects for 1945

Many members have asked what measures the Institute has taken to secure additional paper. The Institute has made several appeals for additional print paper and, during 1943, was granted additional poundage to provide for an inadvertent overusage. However, appeals to increase the base quota have been denied.

In August a supplement to the limitation order was issued which gives the procedure for appeal and also states in a specialized list "factors which shall not be considered as grounds for granting of tonnage on appeals." For the information of members, the following is a partial list of some of the factors that shall not be considered as grounds

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for the granting of appeals. This list is not exclusive.

"1. The nature of a magazine's contents.

"5. Consumption of less paper in 1942 than in other years.

"6. Decrease in circulation, number of advertising pages, or number of editorial pages in 1942.

"10. Inability to maintain or increase advertising pages, editorial pages, or circulation under existing quotas.

"11. Increased demand for a magazine, even though it is published by a membership organization whose constitution requires that a copy be sent to every member."

The Aeronautical Engineering Catalog

Some members have questioned whether the production of the AERONAUTICAL ENGINEERING CATALOG affects the JOURNAL or the REVIEW. The AERONAUTICAL ENGINEERING CATALOG does not affect the allocation of paper for the JOURNAL and the REVIEW, since it is not a magazine and is permitted under a separate W.P.B. limitation order.

Gifts to the Aeronautical Archives

Through the courtesy of Squadron Comdr. James Bird, R.N., and 100 British friends of the Aeronautical Archives, 250 military, naval, and industrial insignia were received from England. Insignia included are those of the Royal Air Force, Royal Australian Air Force, Royal Canadian Air Force, British Army Air Corps, Rhodesian Air Force, New Zealand Air Force, South African Air Force, Czechoslovakian Air Force, French Air Force, Free French Air Force, Free French Fleet Air Arm, Polish Air Force, and 100 British aeronautical manufacturing companies.

John P. V. Heinmuller gave a Lindbergh "Spirit of St. Louis" medal and several air-mail catalogues. A medallion of Eastern Air Transport, Inc., was received from Thomas B. Doe. A wing insigne of the German Luftwaffe was sent by P.F.C. Kenneth Thormann. Miss Jacqueline Cochran gave a Women's Army Service Pilot Wings.

A back file of the *De Havilland Mosquito* was given by de Havilland Aircraft of Canada, Ltd. The Eclipse-Pioneer Division of Bendix Aviation Corporation gave 300 aeronautical magazines, adding to its previous generous gifts. Two copies of *Zweng's Aviation Dictionary* were received from Charles A. Zweng. The Army War College Library sent a complete file of *Abstracts of Selected Periodical Articles of Military Interest*, beginning with No. 1, April, 1944.

The Technical Literature Research of the Research Section of the Bureau of Ships, Navy Department, gave bibliographies on gas turbines, covering Swiss and United States patents from 1925 through 1942, German patents from 1925 through 1943, and technical articles published from 1930 to 1942. The Wings Club, Inc., gave a file of the *Wings Club Bulletin*. The British Air Commission in Washington sent 59 *British Air Ministry Translations*, adding to its previous gifts.

Additional gifts were received from The Consolidated Reporting Company; Consolidated Vultee Aircraft Corporation; Higgins Industries, Inc.; the Independent Committee on Civil Aviation in London; the U.S. Bureau of Aeronautics of the Navy Department; Bureau of Foreign and Domestic Commerce; Civil Aeronautics Administration; Department of Labor; Division of Public Documents of the Government Printing Office; National Archives; National Research Council; Office of the Coordinator of Inter-American Affairs; Smithsonian Institution; Philadelphia Quartermaster Depot of the War Department; House and Senate Document Rooms; and Congressional Committees on appropriations, extension of the Lend-Lease Act, and postwar economic policy and planning.

Sections and Branches

Detroit Section

The following officers were elected for the year 1944–1945: Chairman, John C. Squiers; Vice-Chairman, G. T. Lewand; Secretary, Donald C. Hunt; Treasurer, Philip N. Bright.

New York Section

The first fall meeting of the New York Section was held at the McGraw-Hill Building in New York on Friday, September 15, 1944, at 7:30 p.m. Sixty members and guests attended the meeting. The subject of the meeting was "Notes in Relation to Aircraft Design."

Harold Hoben, of American Airlines, spoke on "Transport Design for the Air-Line Passenger." William A. Straith, President of Taca Airways Agency, discussed "Problems in Central American Operation." Arthur B. Schultz, Chief Engineer of American Aviation, Inc., talked on "Passenger Airplane Design from the Viewpoint of Feeder Pick-up Service." Mr. Schultz also showed a motion picture illustrating various applications of pickup equipment.

"Power Control in Air-line Operation" is the subject chosen by the New York Section for its second fall meeting.

San Diego Section

Military orders made necessary the postponement of the meeting of the San Diego Section scheduled for August 18. Major Knox Manning, who had planned to address the meeting, was directed by his Commanding Officer to attend a military conference at Headquarters with regard to changes in a program of which Major Manning is in charge.

Another meeting will be scheduled as soon as possible, at which time Major Manning will give his address.

Illinois Institute of Technology

At a meeting on August 9 a motion picture, *Building a Bomber*, was shown. Plans for a future field trip were discussed.

On August 16, Homer J. Merchant, Eastern Sales Manager of United Air Lines, was the guest speaker. Mr. Merchant talked about "Air-Line Traffic Control," outlining the meaning of the term traffic in its various aspects, and discussed the efforts of the air lines to provide comfort and safety for passengers.

Iowa State College

The meeting on July 13 was called to order by the Honorary Faculty Chairman, Prof. W. C. Nelson. An election of officers was held and the following were chosen: Chairman, J. M. Ryken; Vice-Chairman, Robert Johnson; Secretary-Treasurer, James Polski.

Dr. Carr of the Physics Department gave a talk on "Private Flying" in which he told of some of his cross country flights and showed numerous colored slides of pictures taken from the air on these trips.

An outdoor meeting was held on the evening of August 9 at which softball games were played. The prize for the eight members of the winning team was a flight in Prof. W. C. Nelson's plane.

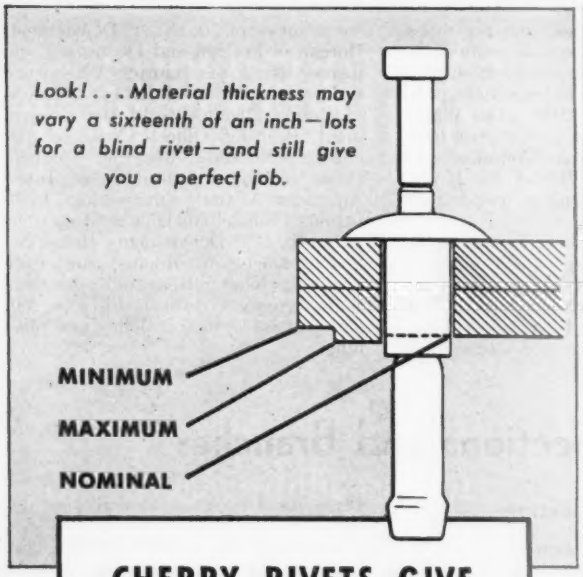
The meeting then proceeded indoors where an election was held for Junior and Senior Engineering Council Representatives. John Yardley was chosen Senior Representative; Eugene Wishnuff, Junior Representative.

The meeting of August 23 was held at the Memorial Union, where a Lockheed film on *The Flight Characteristics of the P-38* was shown.

University of Minnesota

At a meeting held on May 24 the following officers were elected: Chairman, James Ackerman; Vice-Chairman, Robert Evanson; Secretary, Lucy Luck; Treasurer, Colleen Sundry.

M. B. Cahill, Chief Test Pilot of the Minneapolis-Honeywell Regulator Company, spoke about the procedures in flight research.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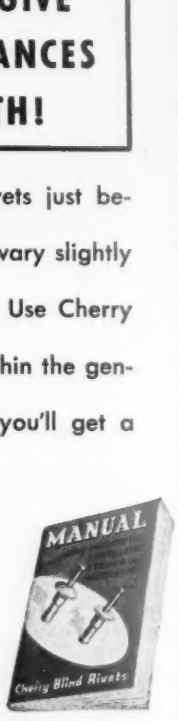

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University of Texas

At a regular meeting on August 30 the guest speaker was Lieutenant French, Inspection and Maintenance Officer of the Troop Carrier Command at Bergstrom Field. He spoke about the work of inspection and maintenance of military aircraft. At the conclusion of his talk a question-and-answer session was held, with Lieutenant French answering questions from the audience. He has been in the Army Air Forces for more than 18 years and has been in action in the campaigns in North Africa and Italy.

News of Members

Ralph G. Allrud has been commissioned an Ensign in the U.S. Naval Reserve.

Alison M. Arnold has received his commission as an Ensign in the U.S. Naval Reserve.

Leonard Arnow has joined the staff of Langley Memorial Aeronautical Laboratory as an Aeronautical Engineer.

Clarence M. Belinn has been elected President of the Los Angeles Airways, Inc.

Laurance H. Cooper was transferred to the Miami Division of Consolidated Vultee Aircraft Corporation, as Division Manager.

Joseph Flatt has received his commission as an Ensign in the U.S. Naval Reserve.

Irving Forsten is now an Aeronautical Engineer at the Langley Memorial Aeronautical Laboratory of the N.A.C.A.

Thomas F. Francis has joined Consolidated Vultee Aircraft Corporation as an Engineering Test Pilot.

Donald B. Guy has been commissioned an Ensign in the U.S. Naval Reserve.

Leonard S. Hobbs, formerly Engineering Manager of the Pratt & Whitney Aircraft Division of the United Aircraft Corporation, has been elected Vice-President for Engineering and a member of the Operating and Policy Committee of the Corporation.

Robert H. Hinckley has resigned as Assistant to the President of the Sperry Corporation to accept an interim appointment by President Roosevelt as Director of Contract Settlement.

T. P. Wright.

James P. Kearns, Jr., has joined the Ames Aeronautical Laboratory of the N.A.C.A. as an Aeronautical Engineer.

George J. Keto is now an Ensign in the U.S. Naval Reserve.

Paul Kleinman has joined Edo Aircraft Corporation as a Stress Analyst.

John H. Knight has been elected President of the Bronx County Chapter of the New York State Society of Professional Engineers.

Alfred Marchev, President of Republic Aviation Corporation, is the new President of the Aircraft War Production Council, East Coast, Inc., succeeding Victor Emanuel.

Howard L. Mingos was recently elected President of Lanciar Publishers, Inc.

Arthur Nutt has retired as Vice-President of Engineering at Wright Aeronautical Corporation, completing 28 years of work on Wright and Curtiss aircraft engines. He had been connected with the company and its predecessors since 1916.

Yves Nubar is now Director of Research and Development with Hub Industries, Inc.

Cyril E. Richards has become an Ensign in the U.S. Navy.

Dominick R. Scolaro recently joined the Ranger Aircraft Engines Division of Fairchild Engine & Airplane Corporation as a Production Engineer.

John W. Sharp is now an Analysis Engineer in the Flight Test Department of Boeing Aircraft Company.

Earl R. Southee has been appointed Manager of the Aviation Section of Hilliard Corporation.

Warren B. Spacy is now Chief Draftsman with the Engineered Riveting Equipment Company.

Philip A. Waze has become connected with Republic Aviation Corporation.

Theodore W. Wilkins has entered the service of American Airlines, Inc., as a Flight Engineer.

Omer L. Woodson, formerly Vice-President and Manager of Bell Aircraft Corporation, has been elected Vice-President in Charge of the Aviation Branch of Hughes Tool Company.

Theodore P. Wright, formerly Director of the Aircraft Resources Control Office of the War Production Board, has been appointed Civil Aeronautics Administrator.

Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Garbell, Maurice Adolph, D.Sc.; Consolidated Vultee Aircraft Corp.

Hammen, Theodore Frederick, Jr., M.S. in Ae.E.; Mgr., Field & Installation Engineering, Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corp.

Elected to MEMBER Grade

Flagg, Henry Collins, B.A.; Structural Test Engineer, Grumman Aircraft Engineering Corp.

Fredericks, William Walter, B. of Ae.E.; Chief Structural Engineer, Stinson Div., Consolidated Vultee Aircraft Corp.

Gatewood, Buford Echols, Ph.D.; Acting Chief Structural Engineer, McDonnell Aircraft Corp.

Goda, Herbert Louis, B. of Ae.E.; Ensign, U.S. Naval Reserve.

Hecht, Marjorie, Draftsman & Layout, Sikorsky Aircraft Div., United Aircraft Corp.

Henshaw, Richard Charles, Chief Engineer, Lord Mfg. Co.

Houston, John Pollard, Lt., Asst. Chief Engineer, A & R Dept., U.S. Naval Reserve.

Hurst, Peter F., Executive Vice-President, Aeroquip Corp.

Lauck, John Alfred, Bachelor Industrial Engineering; Chief Engineer, Pesco Products Co.

Mageoch, H. Yale, Chief Engineer, Lear, Inc.

Sack, Edward Emanuel, B.S. in Ae.E.; Lt. Comdr., Power Plant Design Branch, Bureau of Aeronautics, Navy Dept., U.S. Navy.

Triplett, Dean Franklin, Asst. Chief, Ground School Section, C.A.A.

Wallace, Robert Bruce, B.S. in M.E.; Project Engineer, Plant #11, Pesco Products Co.

Transferred to MEMBER Grade

Farrar, Nadim, B.S. in C.E.; Design and Weights Engineer, Rohr Aircraft Corp.

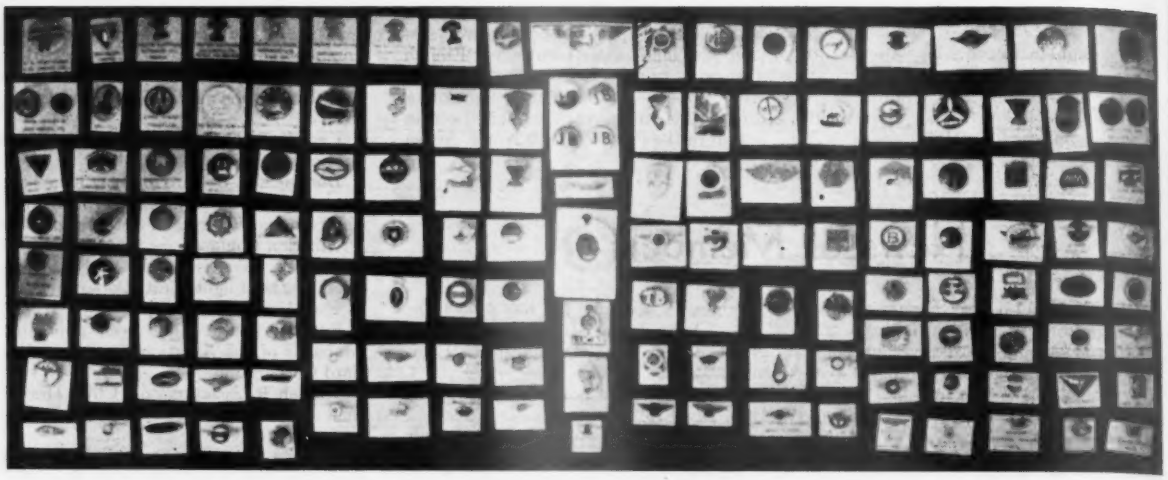
Elected to Industrial Member Grade

Johnson, Emery Franklin, Director, Air Express Div., Air Transport Association of America.

Willis, Calmer Brinton, Aircraft Technical Serviceman, Aircraft Div., Pittsburgh Plate Glass Co.

Elected to Technical Member Grade

Bresler, Boris, B.S. in C.E.; Stress Analyst, Consolidated Vultee Aircraft Corp.



Insignia received from English aircraft companies for exhibition in the Aeronautical Archives.

Einarsson, Einar Harold, Estimator, Production Engineering Dept., Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corp.

Harris, Waldo, Wing Engineering Officer, U.S. Marine Corps.

McGowan, Thomas William, Aero. Draughtsman, Baldonnel Aerodrome, Defense Forces.

Puder, Roland Walter, Lt., Engineering Officer (Aircraft), U.S. Army Air Forces.

Zweng, Allan Churchill, Technical Advisor, Pan American Navigation Service.

Transferred from Student to Technical Member Grade

Bowles, Eldred LeRoy, B.S. in M.E.; Armament Engineering Draftsman, North American Aviation, Inc.

Chapman, Dean Roden, M.S.; Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Clark, Richard Kinsey, B.S.E.

Cleveland, Frank Allen, M.A.; Mech. Engr., Grade P-1, Aircraft Engine Research Lab., N.A.C.A.

Cooney, Thomas Vincent, B.S.A.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Galster, George Milton, B.Ae.E.; Flight Research Engineer, Ames Aero. Lab., N.A.C.A.

Gwinn, Robert Earl, B.S. in Ae.E.

Heppe, Ralph Richard, A.B.; Research Asst., Stanford University.

Johnsen, Howard Henry, B.S.A.E.; Aerodynamicist "B," Consolidated Vultee Aircraft Corp.

Juul, Taga Elmer, B.Ae.E.; Jr. Aero. Engr., Ames Aero. Lab., N.A.C.A.

Kearns, James Patrick, Jr., B.S. in Ae.E.; Engineer Designer, Louisville Div., Consolidated Vultee Aircraft Corp.

Kindler, Ralph August, B.S.; Sr. Stress Analyst, Hughes Aircraft Co.

Klein, Myer, Layout Engineer, Stout Research Div., Consolidated Vultee Aircraft Corp.

Lindow, Carl Victor, Stress Analyst, Noorduyn Aviation Ltd.

Loufek, John Elliot, B.S.A.E.; Aero. Engr., P-1, Langley Mem. Aero. Lab., N.A.C.A.

Mayer, John Prosper, B.S.A.E.; Aero. Engr., Langley Mem. Aero. Lab., N.A.C.A.

Meyers, Garry Cleveland, Jr., B.S.; Aero. Engr., Langley Mem. Aero. Lab., N.A.C.A.

Olson, Oscar Leonard, Jr., B.S.A.E.; Engineer, The Glenn L. Martin-Nebraska Co.

Pliske, Daniel Robert, B.S.A.E.; Aero. Engr., Ames Aero. Lab., N.A.C.A.

Ponsford, Henry Thomas, A.B. in Engineering, Research Asst., Stanford University.

Sameshima, Ko Stanley, B.S.A.E.

Sherman, Patrick Arthur, B.S.M.E.; Ensign, U.S. Navy.

Steffens, Jerome, B.A.E.; Jr. Aero. Engr. (Stress Analyst), Engineering & Research Corp.

Vlastnik, Lawrence, B.S. in Ae.E.; U.S. Navy.

Wood, Herbert Turner, Jr., B.S. in M.E.; Engineering Asst. "A," Plant A-1, Lockheed Aircraft Corp.

Zmola, Paul Carl, B.S. in M.E.; Asst. Engineer, Western Electric Co.

Zwierzynski, Joseph Anthony, B.A.E.; Liaison Engineer, Briggs Mfg. Co.

Elected to Affiliate Grade

Ahnstrom, Doris Newell, Managing Editor, *Skyways* Magazine, Henry Publishing Co.

Dayhoff, Clarence Wilson, Asst. Western Regional Traffic Mgr., Transcontinental & Western Air, Inc.

Dixon, John Alexander, Test Engineer, Consolidated Vultee Aircraft Corp.

Necrology

Philip Gustav Johnson

Philip Gustav Johnson, President of Boeing Aircraft Company, died at St. Francis Hospital in Wichita, Kan., on September 14, following a stroke suffered during the evening of September 12. He had stopped at Wichita for a routine visit with officials of the local Boeing organization while returning to Seattle from the East. He was a Vice-President of The Institute of the Aeronautical Sciences in 1941.

Mr. Johnson was 49 years of age. Born at Seattle on November 5, 1894, he was a graduate of the College of Mechanical Engineering of the University of Washington. He entered the employ of the Boeing Airplane Company as a draftsman in 1917, advancing to the positions of plant superintendent in 1919, Vice-President and General Manager in 1922, and President in 1926. The Boeing company was reorganized as the United Aircraft & Transport Corporation in 1931, with Mr. Johnson serving as President until its division into a group of independent corporations in 1934. He was invited to Canada in 1937 to organize the Trans-Canada Airlines, which he built up into an important transcontinental air transport unit serving a large portion of the Dominion.

He was invited to resume his former connection with the Boeing organization in 1939 and was elected President of Boeing Aircraft Company, the office that he held at the time of his death.

Mr. Johnson is credited with much of the organizational progress of the Boeing company and its great record in the production of aircraft for the Army and Navy. He was a leader in the installation of incentive programs for employees and in improving working conditions in the plants of his companies. To his ability as an organizer and executive is credited a large part of the success of the Boeing organization in producing the Flying Fortresses and Superfortresses.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge

by writing to the Secretary of the Institute.

WANTED

Detail & Layout Draftsmen, Stress Analysts, Design Engineer, Assistant Project Engineer on development work in the engineering department. Address inquiries to Edo Aircraft Corporation, 136-48 Roosevelt Avenue, Flushing, L.I., N.Y.

Graduate Engineer—Draftsman—Excellent immediate and postwar opportunity. Design airplane accessories. Aeronautical experience necessary. Particular reference to work in hydraulics and alighting gear. Engineering draftsman, with or without aeronautical background, also desired. Write direct, stating education, experience, age, and draft status to Mr. Robert D. Spencer, Manager, Aeronautical Sales & Engineering Department, The General Tire & Rubber Company, Akron, O.

Aeronautical Engineer—graduate or equivalent in experience. Good working knowledge of airplane design, structure, materials, and stress analysis desirable. Background of naval aircraft specifications and manufacture considered excellent. Pleasing personality is essential. Apply or write to the Bureau of Aeronautics Representative, c/o Edo Aircraft Corporation, 13-10 111 Street, College Point, N.Y.

Assistant or Associate Professor: to teach elementary and advanced aerodynamics. Applicant must have a degree in Aeronautical Engineering together with some practical experience in the aircraft industry. Teaching experience desirable but not required. Permanent position. Rank and salary depend upon qualifications. Address inquiries to Dean Robert L. Mann, Spartan College of Aeronautical Engineering, Tulsa, Okla.

Stress Analysts—at least two years' experience on aircraft stress analysis for similar work on plastic aircraft assemblies involving nonwrinkling skin construction. Address inquiries giving education, experience in detail, draft status and salary requirements to Universal Moulded Products Corporation, Bristol, Va., Attention Dr. R. J. Nebesar.

Graduate Junior and Senior Mechanical and Civil Engineers—Excellent immediate and post-war opportunity for qualified engineers who have specialized in Stress Analysis. Must comply with W.M.C. regulations. Apply by letter only to: Lear Avia., Inc., Piqua, Ohio, R. J. Biggs, Special Representative.

Aircraft Engineers—Openings available in progressive Aircraft Company for layout and design engineers to cover Wing, Empennage, Power Plant, Fuselage, Electrical and Radio, Land-

I.A.S. National Air Transport Meeting

The Hotel Statler **Washington, D.C.**

Friday, October 20, 1944

2:00–5:00 P.M. **Congressional Room**

Chairman: *J. Parker Van Zandt*
The Brookings Institution

A Study of Possible Glider Uses in Commercial Operations—Albert E. Blomquist, Major, U.S. Army Air Forces.

A Review of the Aerodynamics of Flight Load Factors in Relation to the Safety Regulations—Hugh B. Freeman, Consolidated Vultee Aircraft Corporation.

Explosive Release Mechanisms for Air Cargo—A. D. Neal and W. L. Spielman, Curtiss-Wright Corporation.

Feeder Line Operations—James G. Ray, Vice-President, Southwest Airways Company.

7:30–11:00 P.M. **Congressional Room**

Chairman: *T. P. Wright*
Civil Aeronautics Administrator

Discussion of the Idlewild Airport—Jay Downer, Consulting Engineer, Airport at Idlewild.

New Developments in Air Traffic Control—Glen A. Gilbert, Chief, Air Traffic Control Division, Department of Commerce, Civil Aeronautics Administration.

Emergency Procedures and Practices in Transoceanic Flight Operations—William H. Hall, Transatlantic Division Engineer, American Airlines, Inc.

Lighting Equipment for Adverse Weather Operations—W. T. Harding, Major, U.S. Army Air Forces.

ing Gear, Hydraulics, Equipment, and Controls. Also openings for Tool Designers, Tool Planners, Production Planners, Loftsmen and Aircraft Drawing, and Template Checkers. Those presently employed in essential war work need not apply. Airmail complete detailed information regarding education, experience, salaries, former employers, age, family status, citizenship, and draft status, in order that we may be able to evaluate your qualifications from the first letter. Address inquiries Higgins Aircraft, Inc., P.O. Box 32, New Orleans 6, La.

Graduate Engineers for essential war work, opportunity for advancement and increased earnings. Aeronautical experience not necessary. Must be citizen, not employed in essential war industry, or have certificate of availability from the U.S. Employment Service Office or War Manpower Commission of your area. Write direct, stating school, age, degree, experience, draft classification, and marital status to Consolidated Vultee Aircraft Corporation, Industrial Training Division, San Diego, Calif.

Aeronautical Engineer wanted for promotional work in expanding line of highly specialized equipment for aircraft, also airway and airport control tower equipment. Must have extensive background in aircraft instrumentation, know the pilot's problems and the requirements of the air lines. Good basic knowledge in aerodynamics, physics, and electronics necessary. Engineering sales and service experience contacting air lines and aircraft manufacturers desirable. Apply Wallace & Tiernan Products, Inc., Belleville 9, N.J.

Chief Design Engineer—Graduate mechanical engineer, experienced on automotive radiators, with established AAA-1 high production manufacturer or automotive radiators. Worth-while salary. Sound peacetime future with resumption of automobile production. Write in complete detail. Enclose recent (non-returnable) photo. Address inquiries to Box 252, Institute of the Aeronautical Sciences.

Industrial Engineers—major coast-to-coast air line, strong background on accounting systems, operating cost accounting and capital items depreciation; must be willing to leave city. Permanent position offering unlimited opportunity. Describe background in detail. Enclose photo. Address inquiries to Box 240, Institute of the Aeronautical Sciences.

Engineers, Industrial, for major coast-to-coast air line with procedural operating analytical experience, also comprehensive knowledge of the flow and control of forms and paper work. Must be willing to leave city—a permanent position, which offers unusual opportunity. Describe background fully. Enclose photo. Address inquiries to Box 239, Institute of the Aeronautical Sciences.

Senior Mechanical Engineers, Junior Mechanical Engineers, Mechanical Draftsmen needed for new aircraft engine programs by an aircraft-engine company in the eastern area. Aircraft-engine experience preferred but not necessary if mechanical background is satisfactory. Proper clearance with the War Manpower Commission necessary. To arrange for an interview, please send your qualifications to Box 232, Institute of the Aeronautical Sciences.

Engineers—Design, aeronautical experience necessary; particular reference to work in hydraulics and structural design; also engineering draftsmen with aeronautical background. Address inquiries to Box 228, Institute of the Aeronautical Sciences.

Aeronautical Engineer—a graduate engineer for work in a postwar development division. Past experience should include performance studies, project design, including engine installations, and some operational knowledge. Broad acquaintance in air lines and manufacturing industry would be an asset. Only those who can secure a release will be considered. Give full résumé, references, and salary requirements. Address inquiries to Box 238, Institute of the Aeronautical Sciences.

AVAILABLE

Aeronautical Development Engineer—College graduate with six years' experience in design and development of commercial and military airplanes desires responsible position in small concern in executive or development capacity. Capable of taking complete charge of new projects. Present position, project engineer. Would consider air-line work. Address inquiries to Box 250, Institute of the Aeronautical Sciences.

Engineering Representative, ten years' aircraft experience in supervision of departments and direction of projects, widely traveled, graduate Aero and Mechanical engineer and business training; desires permanent connection where engineering and business background can be utilized in sales or production; married, will travel. Address inquiries to Box 249, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Ten years' experience including positions as project engineer and chief aerodynamicist. Familiar with wood and metal construction. At present chief aerodynamicist on major helicopter project. Desires responsible position in New York or New England area. Address inquiries to Box 246, Institute of the Aeronautical Sciences.

Graduate Aeronautical Engineer—17 years of practical experience in military and commercial aircraft development, design, and supervision. Acted as consultant, project engineer, and designer in responsible charge of engineering work and personnel with major aircraft companies. Desires responsible and permanent position with aircraft company. Willing to accept position in South America or other suitable foreign country. Address inquiries to Box 245, Institute of the Aeronautical Sciences.

Mechanical-Aeronautical Engineer—5 years, major aircraft stress analysis. Desires connection with west coast airframe or accessories company. Address inquiries to Box 244, Institute of the Aeronautical Sciences.

Layout Draftsman—21 years old, 2 years' experience in large aircraft factory in power plant and wing design; 2 years' experience tool and machine designing; recently honorably discharged from Army. Desire position with postwar future in large aircraft company, preferably in vicinity of New York. Address inquiries to Box 243, Institute of the Aeronautical Sciences.

Helicopter Project Engineer—9 years' experience in aircraft engineering, composed of 1 year as project engineer, 6½ years as structural engineer and 1½ years as weight engineer. Desires position with a company sold on the future of this type of aircraft both for war and postwar use. Address inquiries to Box 242, Institute of the Aeronautical Sciences.

Rotary Wing Engineer: B.S. in C.E., 5 years' experience with leading aircraft manufacturers; 3 years as stress analyst and structural designer, past 2 years' as rotary wing research engineer and helicopter designer. Thoroughly familiar with structural, mechanical, and theoretical problems of rotary wing. Desires position as project or design engineer on existing project or preparing original designs with responsible organization prepared to actively undertake helicopter development. Address inquiries to Box 241, Institute of the Aeronautical Sciences.

Inspector and Production Engineer—5 years' experience in high-altitude fighter planes, desires employment with transport air line having postwar future. B.S. degree; linguist; any location. Address inquiries to Box 237, Institute of the Aeronautical Sciences.

Graduate Engineer, 5 years' experience, varied, in production control, planning, cost estimating and control, tooling, engineering, weights, and aerodynamics. Permanently draft deferred, single, release available, present salary $7,000 per year. Considerable experience in writing and preparation of technical reports, specifications, and proposals. Over a year's experience in Helicopter engineering and aerodynamics. Wants responsible

position, permanent, in production or engineering with reputable firm, preferably in East but will travel if necessary. Address inquiries to Box 236, Institute of the Aeronautical Sciences.

Director of Quality, Chief Inspector for aircraft construction contact with Army or Navy (Navy preferred), 20 years' aircraft experience, also interested in aircraft maintenance, overhaul and repair. Address inquiries Box 230, Institute of the Aeronautical Sciences.

Structural Aeronautical Engineer—20 years in responsible positions as project, liaison and development engineer on military and commercial aircraft. Desires similar air cargo or definite eastern post war connection. Address inquiries to Box 217, Institute of the Aeronautical Sciences.

Consultant Aeronautical Engineer recently discharged Army Air Forces, formerly executive Chief Engineer, desires additional consultant work under contract. Address inquiries to Box 205, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. and M.S. Degrees. Nine years' experience in structures, wind-tunnel testing, weights, and flight testing. Have been chief of structures for three well-known manufacturers. Desire commensurate position with company having postwar possibilities. Address inquiries to Box 251, Institute of the Aeronautical Sciences.

(*Continued from page 141*)

problems of Brazil and show how aviation fits into the future development.

Meteorología Descriptiva, by Carlos E. Constantino; Editorial Sopena Argentina, S.R.L., Buenos Aires, 1943; 485 pages.

This is a useful and practical volume that treats the subject in a concise but thorough manner. All phases of meteorology are presented, from the historical as well as from the scientific point of view, in such a way as to make the reading of the book interesting even to the layman. Technical data, tables, and information make the book suitable for reference purposes.

Die Differential- und Integralgleichungen der Mechanik und Physik (Differential and Integral Equations of Mechanics and Physics), by Philipp Frank and Richard von Mises, Vol. 1, Mathematics; Vol. II, Physics; published and distributed in the public interest by the authority of the Alien Property Custodian, by Mary S. Rosenberg, New York, 1943; 2 volumes, $27.50 a set.

These volumes constitute the second enlarged edition, and the 8th edition of Riemann-Weber's Partial Differential Equations of Mathematical Physics. The authors explain that, although they may be reproached for taking the liberty of including the Riemann-Weber title with that of their work, they consider it a duty to preserve the names of these scientists in the memory of the younger generation. Since the Riemann-Weber work was published, the material to be treated has increased to such an extent that a complete new division of the entire study, as well as a detailed revision of all the parts, became imperative in order to give the physicist a sufficient basis for the mathematical approach to his problems.

The most significant change made by the authors is the division of the work into a mathematical part (Vol. 1) and a physical part (Vol. II) for greater clarification. It is scarcely to be expected that any reader will peruse these books from cover to cover. He will find it best to start from the chapter that deals with the subject in which he is especially interested and go back, if necessary, to the numerous references to be found in the text. These books may be regarded as an authoritative source of information that should be welcomed by every physicist.

Manometric Methods as Applied to the Measurement of Cell Respiration and Other Processes, by Malcolm Dixon; The Macmillan Company, New York, 1943; 155 pages, $1.75.

The second edition of a book dealing with the application of manometric measurement to cell respiration and other processes. The book gives the theories and practical details of methods used in following reactions in which a gas is either absorbed or evolved. These methods are employed in biological laboratories, including those carrying out research in aviation medicine, as well as in laboratories of applied science.

The book has been revised to cover recent advances in the methods and improvements in technique. New sections on the measurements of serum and a list of many of the systems that have been studied and of substances that can be conveniently estimated manometrically have been added.

Spinney and Spike and the B-29, by Lavinia R. Davis; Charles Scribner's Sons, New York, 1944; 112 pages, $1.75.

This is a children's story about the visit of two small boys to an Army Air Corps base. As viewing a Superfortress is one of the highlights of the visit, the features of this plane are identified for a child's recognition.

Lieutenant Bertram, by Bodo Uhse, translated from the German by Catherine Hutter; Simon and Schuster, New York, 1944; 430 pages, $2.50.

This novel has as its background the early days of the Luftwaffe. It is the story of a young Nazi pilot who becomes involved in intrigues and the network of the Gestapo.

The Germans transform a small island into an underground hangar. Many classes of people are introduced and all show the tense emotions prevailing while the air power of Germany was being secretly prepared for future eventualities.

The scene shifts to Spain where the aircraft squadron fights the Russians. The experiences of the pilots show the great disappointments they felt in their association with the Italians.

The novel is a richly detailed revelation of the German military caste and the people who live around them. It is one of the first books that give an intimate view of the lives of German airmen. The author was a Nazi who went through the Spanish war. He escaped to France, where he began to write this novel.

Rifles and Machine Guns; A Modern Handbook of Infantry and Aircraft Arms, by Capt. M. M. Johnson, Jr.; William Morrow and Company, New York, 1944; 390 pages, $5.00.

This handbook of infantry and aircraft arms is offered as a practical guide to important modern military small arms. It is intended primarily for those who use or maintain weapons in service. United States and foreign weapons of the period of World War II from the rifle and pistol to the aircraft machine gun are described and analyzed.

Following a classification and a discussion of the general function of weapons, the history of small arms is outlined from 1900 to the present date. More than 60 specific weapons are analyzed and discussed in detail in the following categories: clip-loaded rifles and semiautomatic rifles; charger-loaded arms; charger-loaded semiautomatic rifles; automatic or machine rifles and light machine guns; antivehicle weapons—calibers 0.50, 0.55, 20 mm. (0.78 in.); and submachine guns, carbines, and pistols.

Seamless Steel Tube Data Book; Seamless Steel Tube Institute, Pittsburgh, 1944; 320 pages, $2.50.

A loose-leaf data book that contains 320 pages of information about steel tubing is divided into four principal sections. These are designated as general data, mechanical tubing, pressure tubing, and reference tables. A guide index is included.

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Solution Heat Treated 12 hrs. at 980° F., quenched in boiling water & aged 3 hrs. at 310° F.	35,000	25,000	2½
Solution Heat Treated 12 hrs. at 980° F., quenched in boiling water & aged 3 hrs. at 400° F.	42,000	37,000	1½

ANALYSIS

Copper	1.25-1.75	Zinc	0.2-0.4	Titanium	0.2 Max.
Silicon	5.0-6.0	Manganese	0.3-0.9	Others	0.2 Max.
Magnesium	0.35-0.55	Nickel	0.2 Max.	Aluminum	Balance
Iron	0.5 - 0.9	Chromium	0.2 Max.		

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